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(54) **AUTOMATIC BREAD MAKER**

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(52) **U.S. Cl.** **99/325**; 99/538; 99/348

(57) **ABSTRACT**

An automatic bread maker (**1**) comprises: a bread container (not shown) into which bread ingredients are put; a body (**10**) having an accommodation part (**30**) for accommodating the bread container; a grinding blade (not shown) for grinding cereal grains inside the bread container accommodated in the accommodation part (**30**); and a duct (**16**) and fan (**17**) for creating an airflow for cooling the accommodation part (**30**) using ventilation holes (**32**, **33**) provided to the accommodation part (**30**).

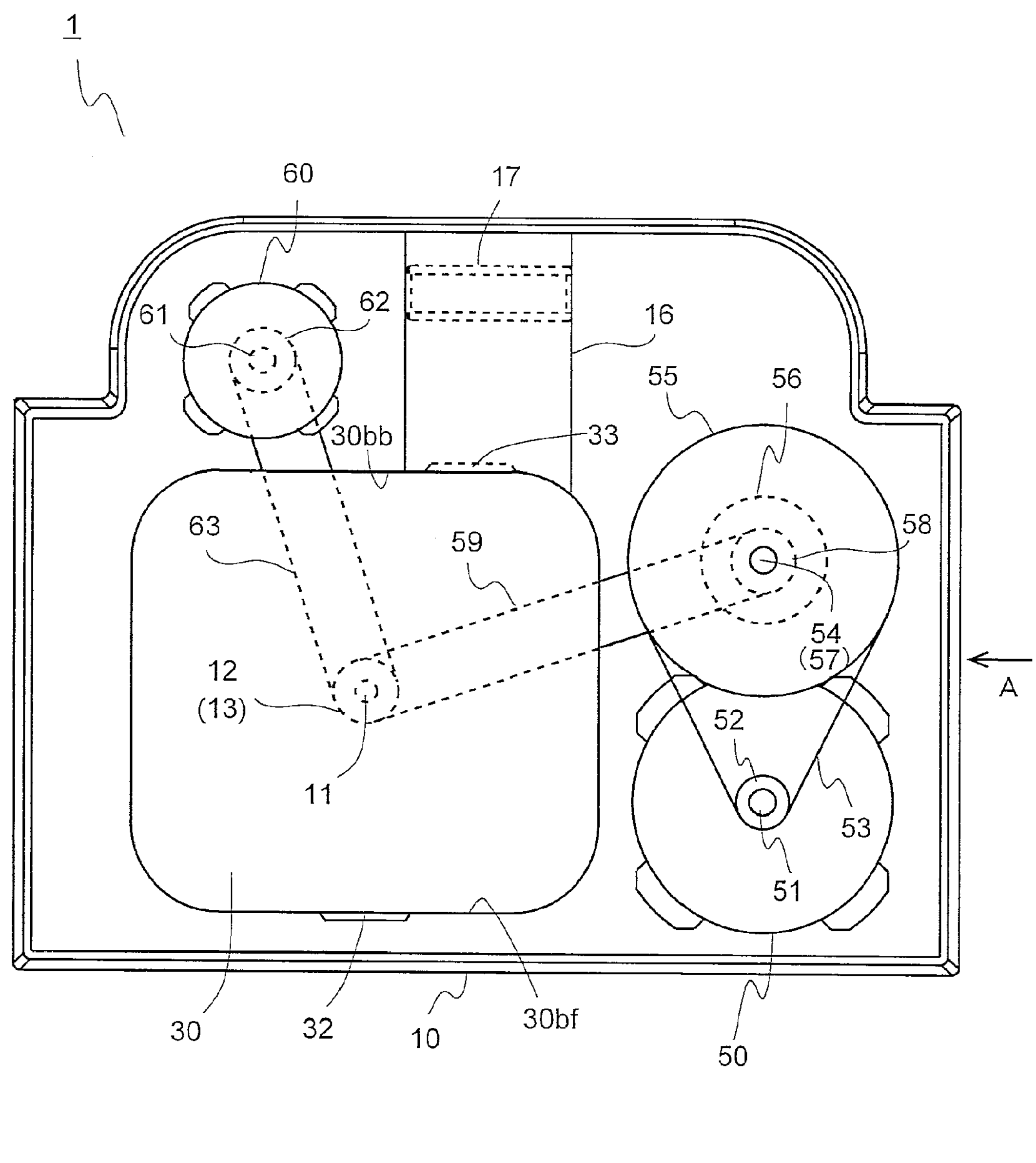


FIG.1

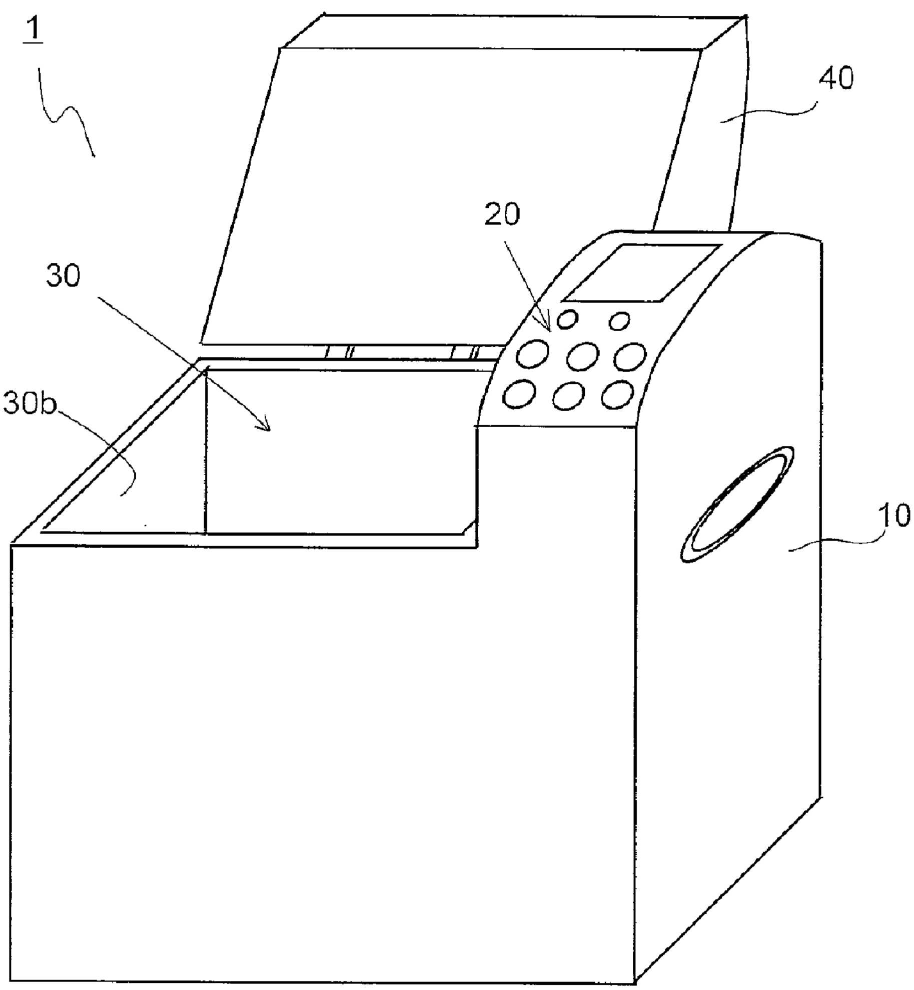


FIG.2

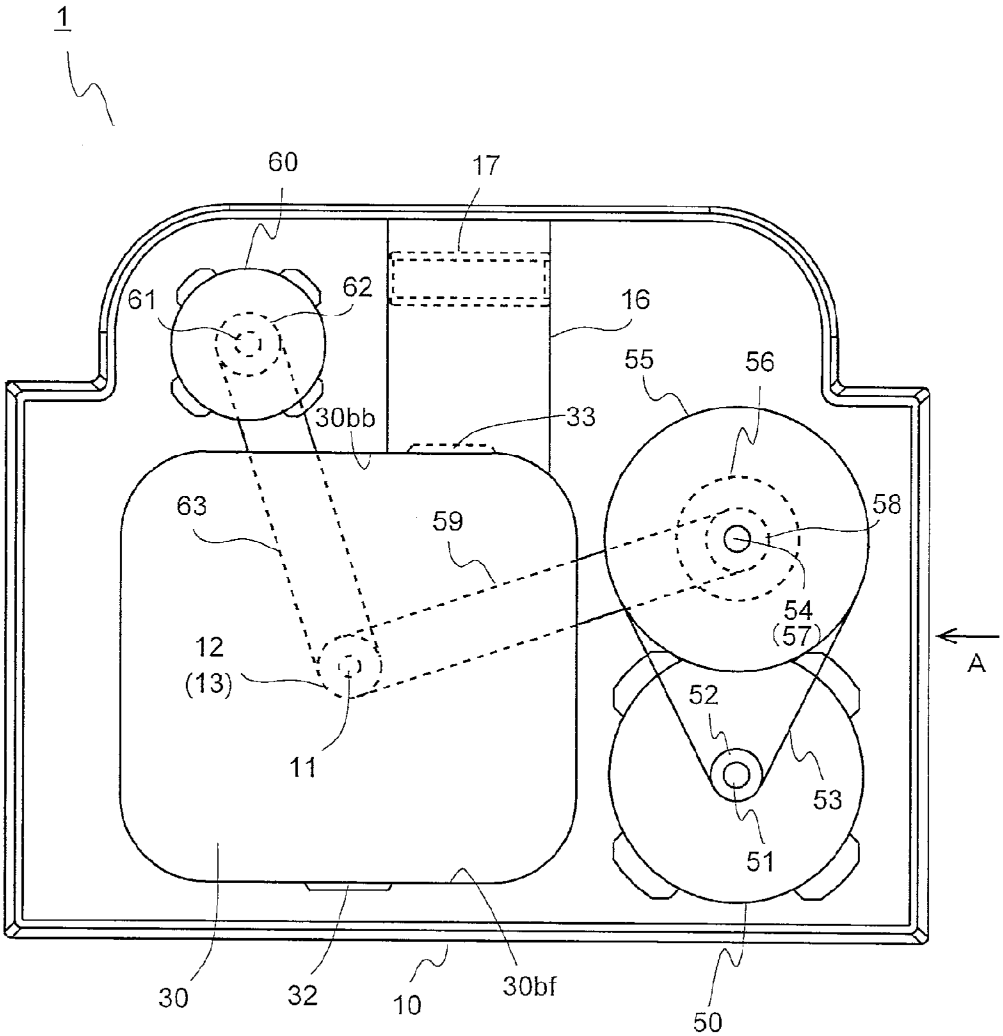
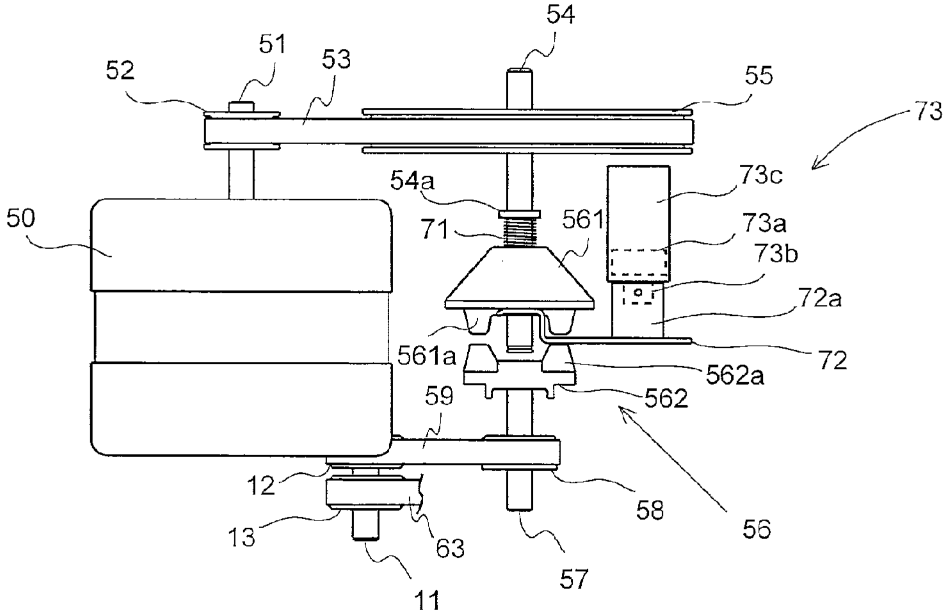

1
60
17
61
62
16
55
56
30bb
33
63
59
58
54
(57)
12
(13)
A
52
11
53
51
30
32
10
30bf
50

FIG.3A


54
51
52
53
55
73
73c
54a
50
71
561
73a
73b
72a
561a
72
562a
562
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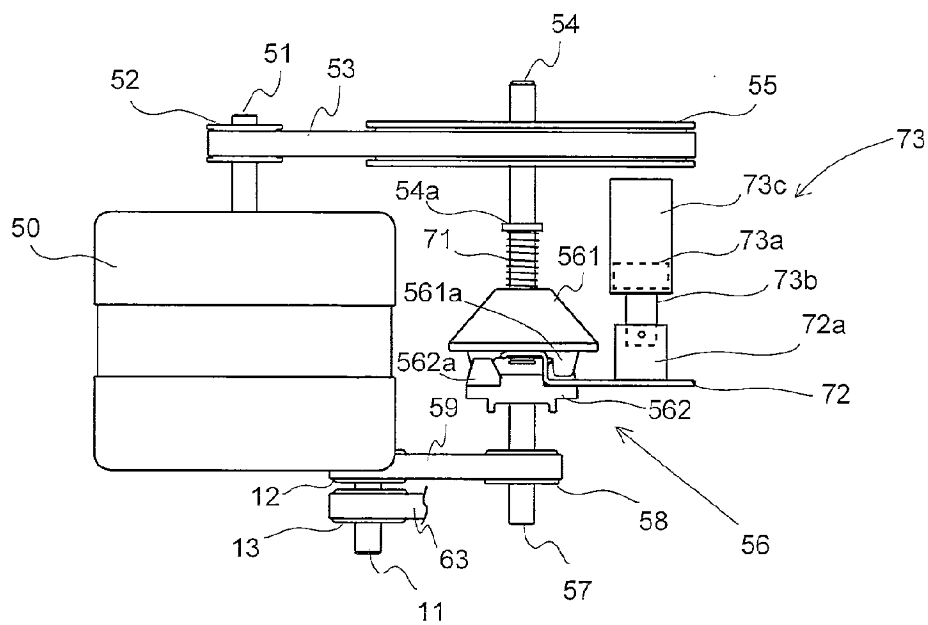
12
58
56
13
63
57
11

FIG.3B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51
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53
55
73
73c
54a
50
71
73a
561
73b
561a
72a
562a
72
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58
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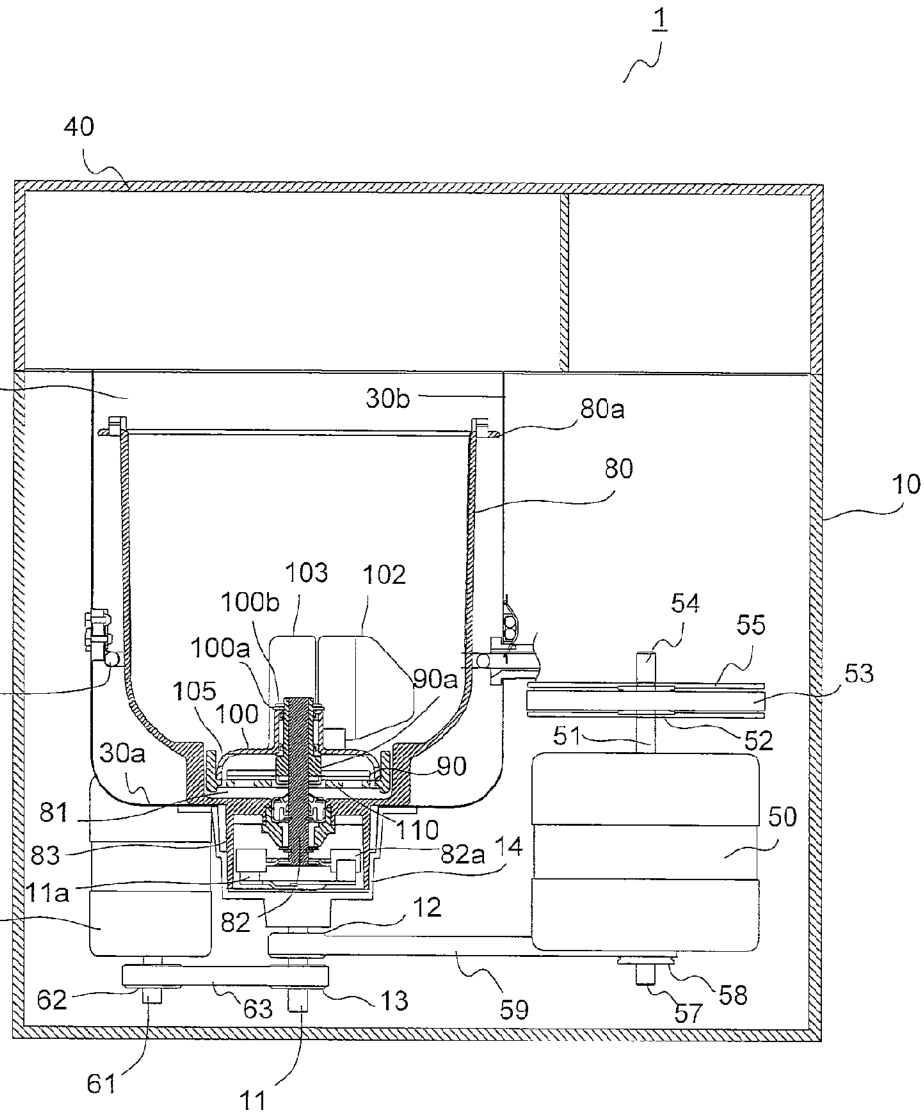
13
63
57
11

FIG.4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30b
80a
80
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100b
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100a
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90a
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100
52
51
30a
90
81
110
50
83
82a
14
11a
60
12
82
62
63
13
59
58
57
61
11

FIG.5

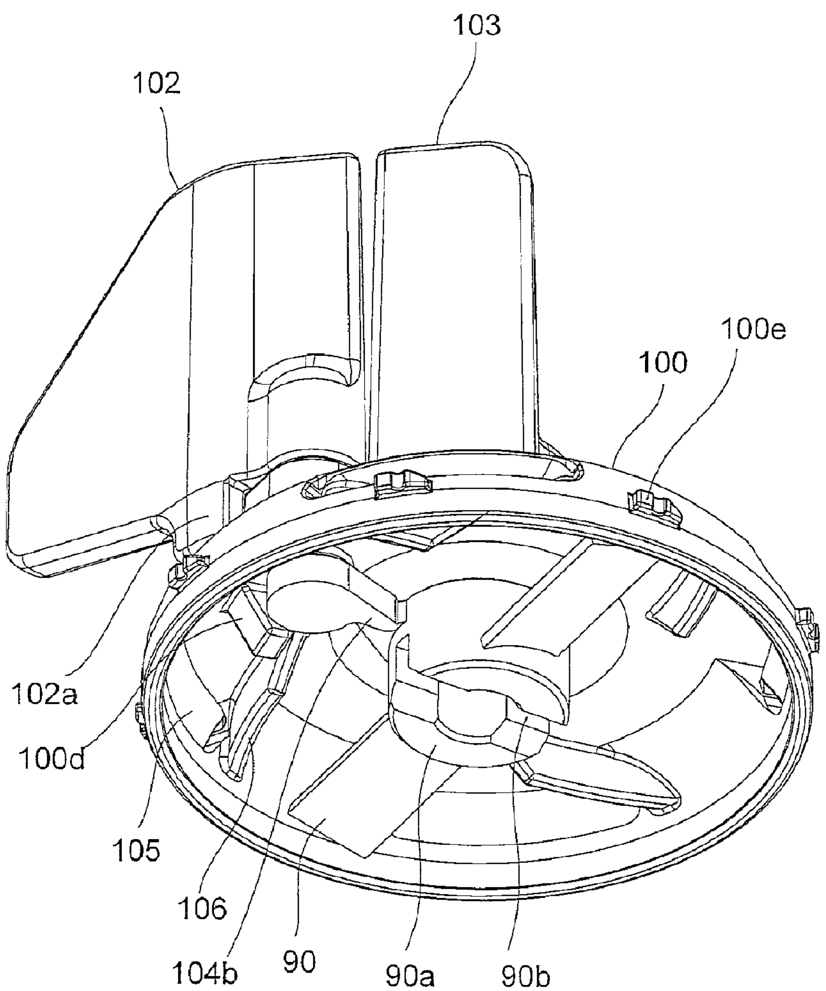


FIG.6

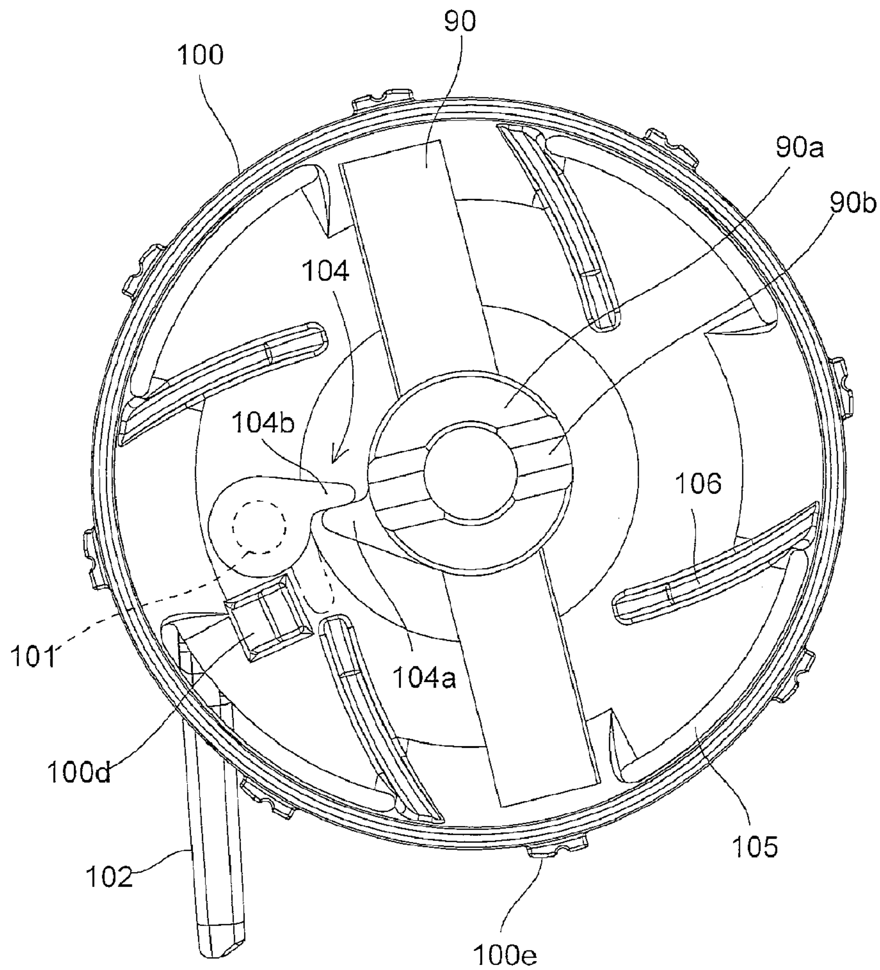


FIG.7

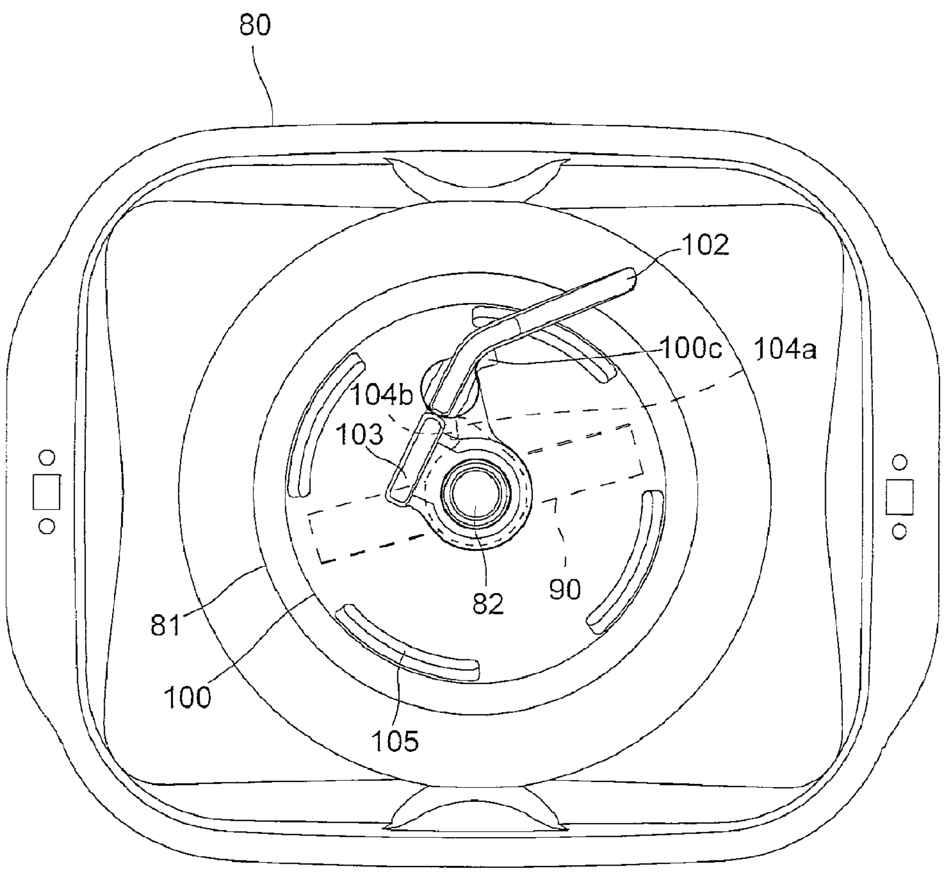


FIG.8

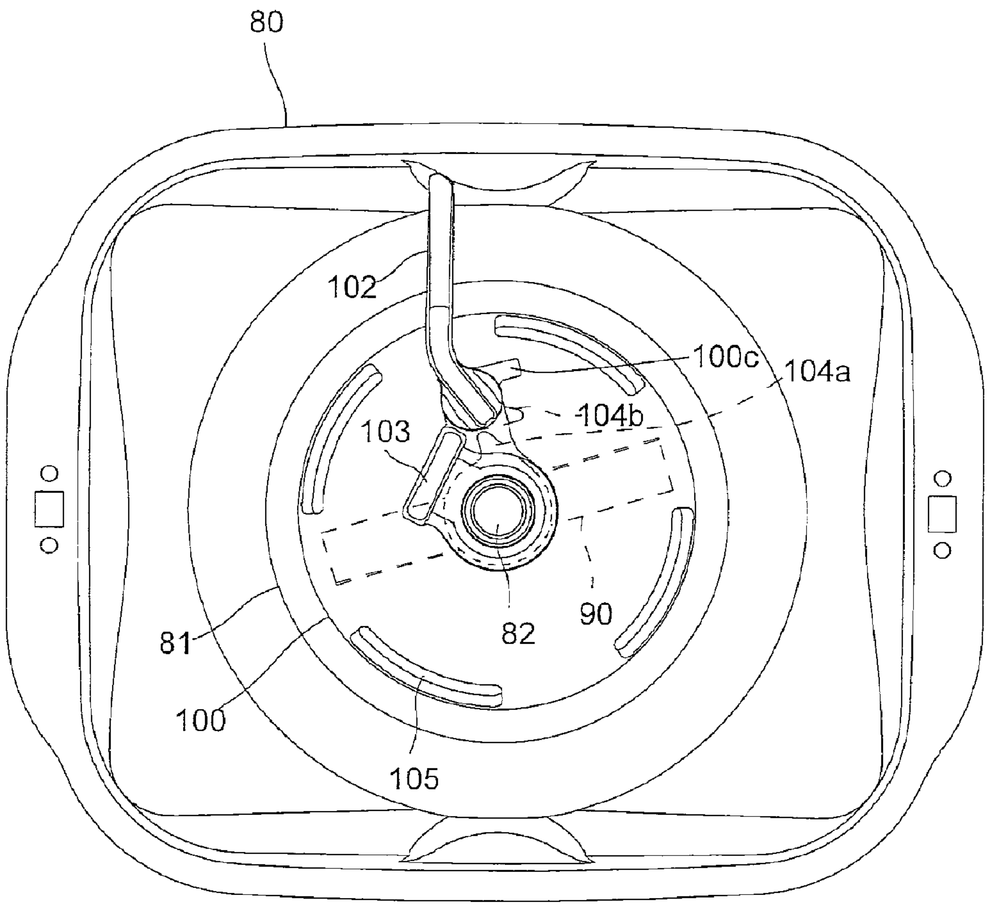


FIG.9

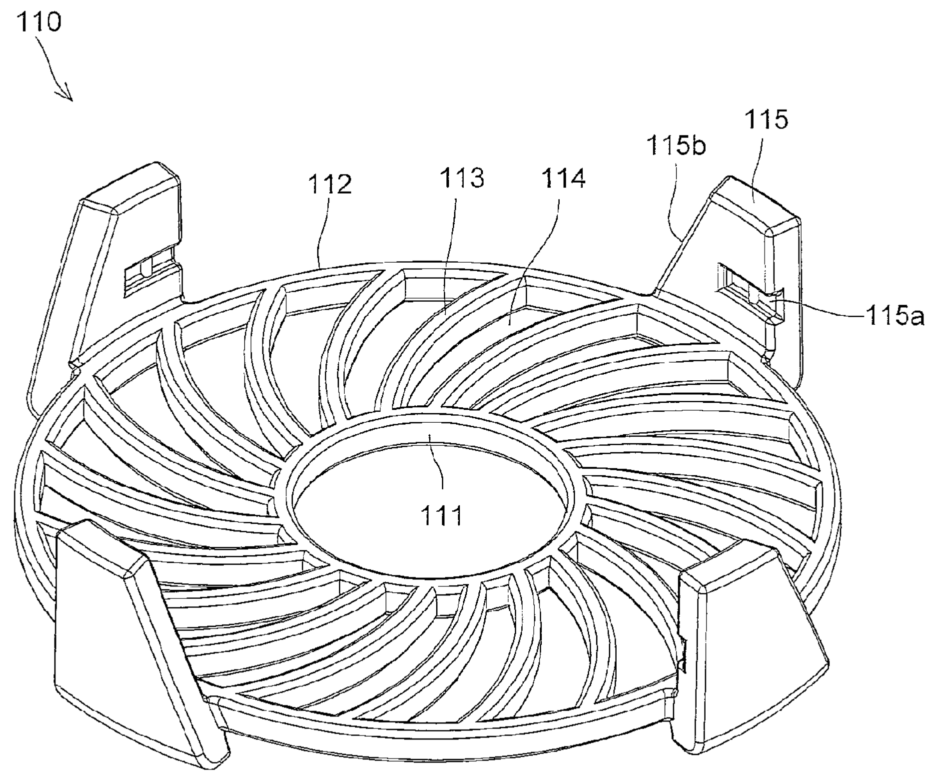


FIG.10

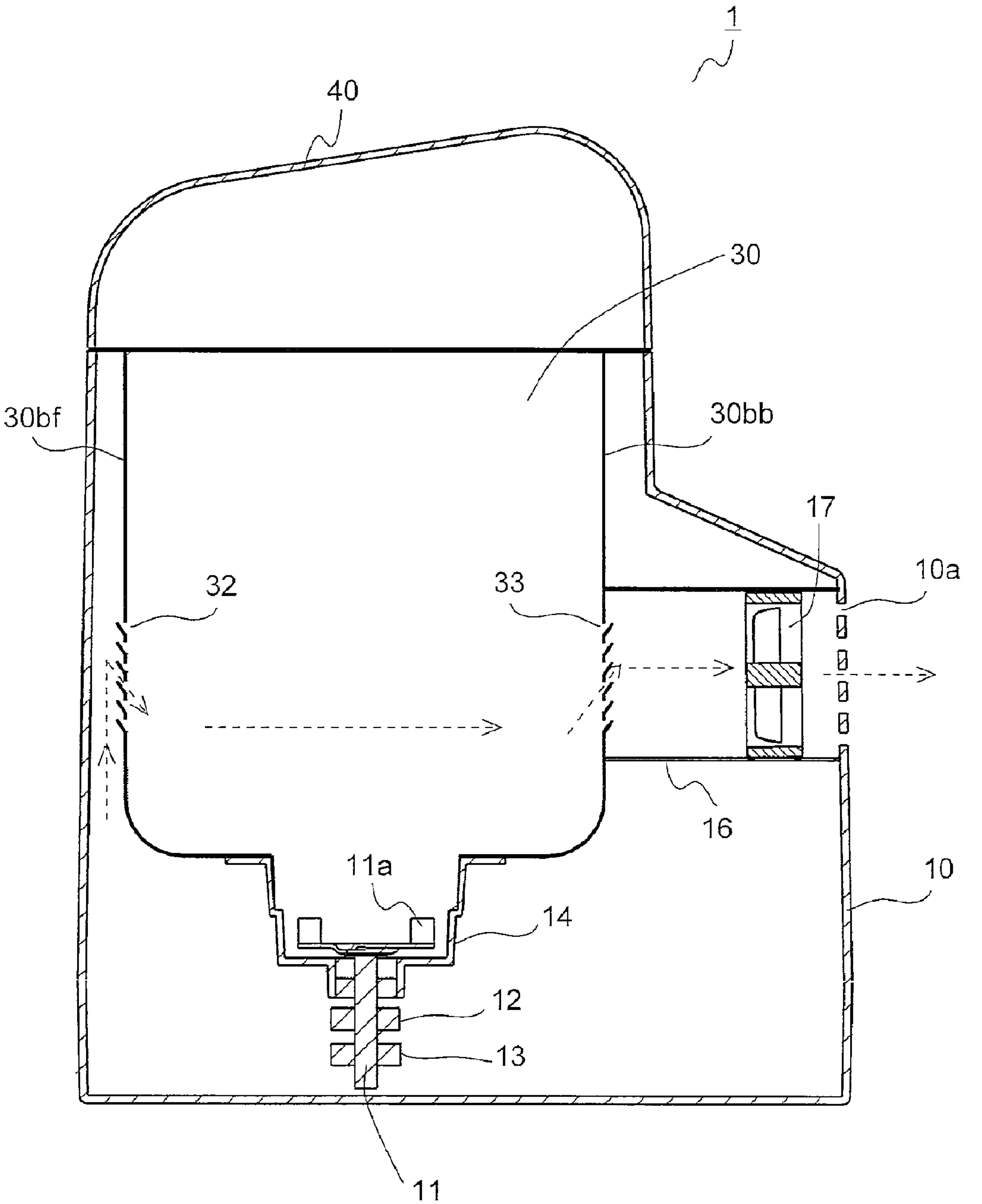
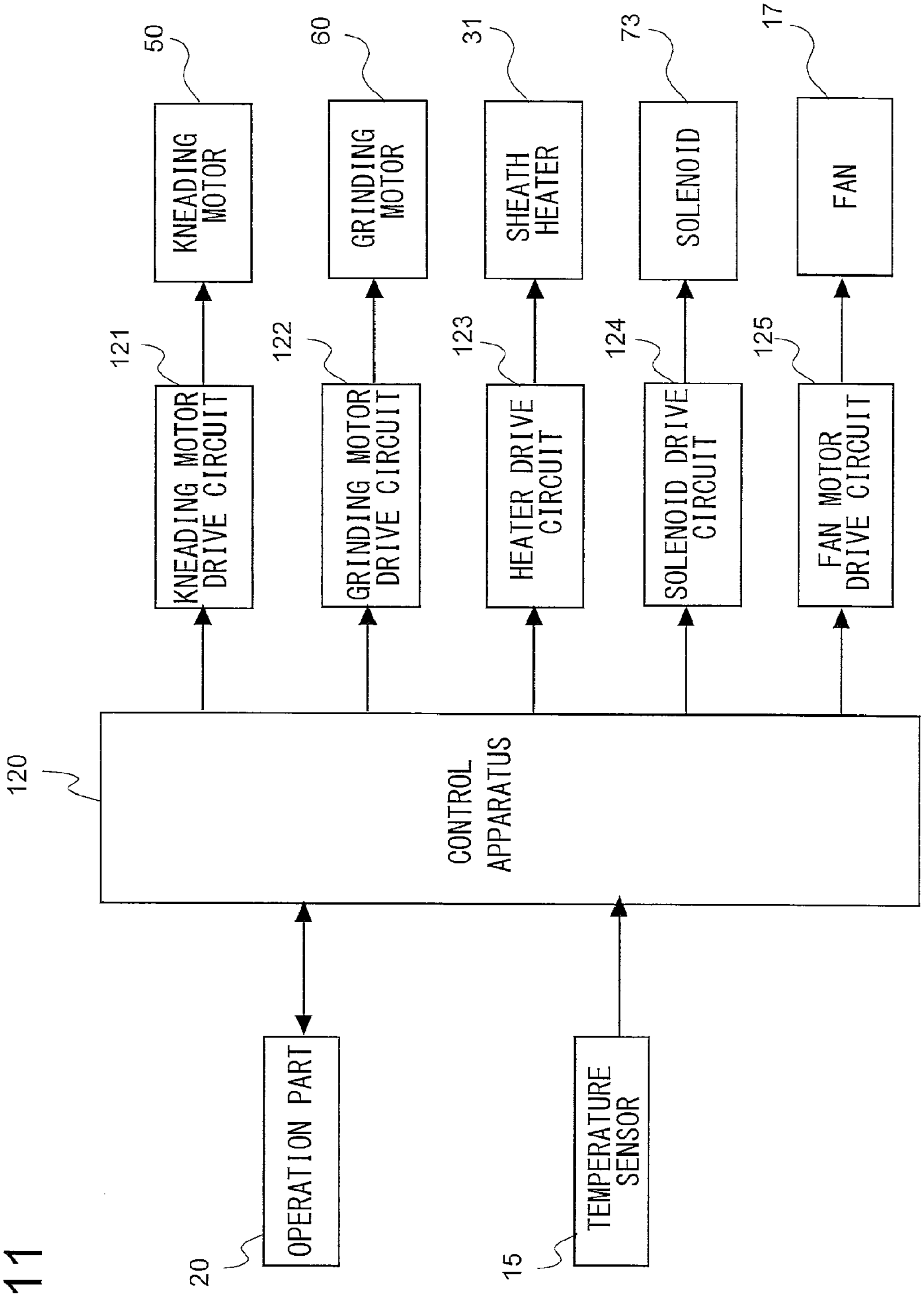
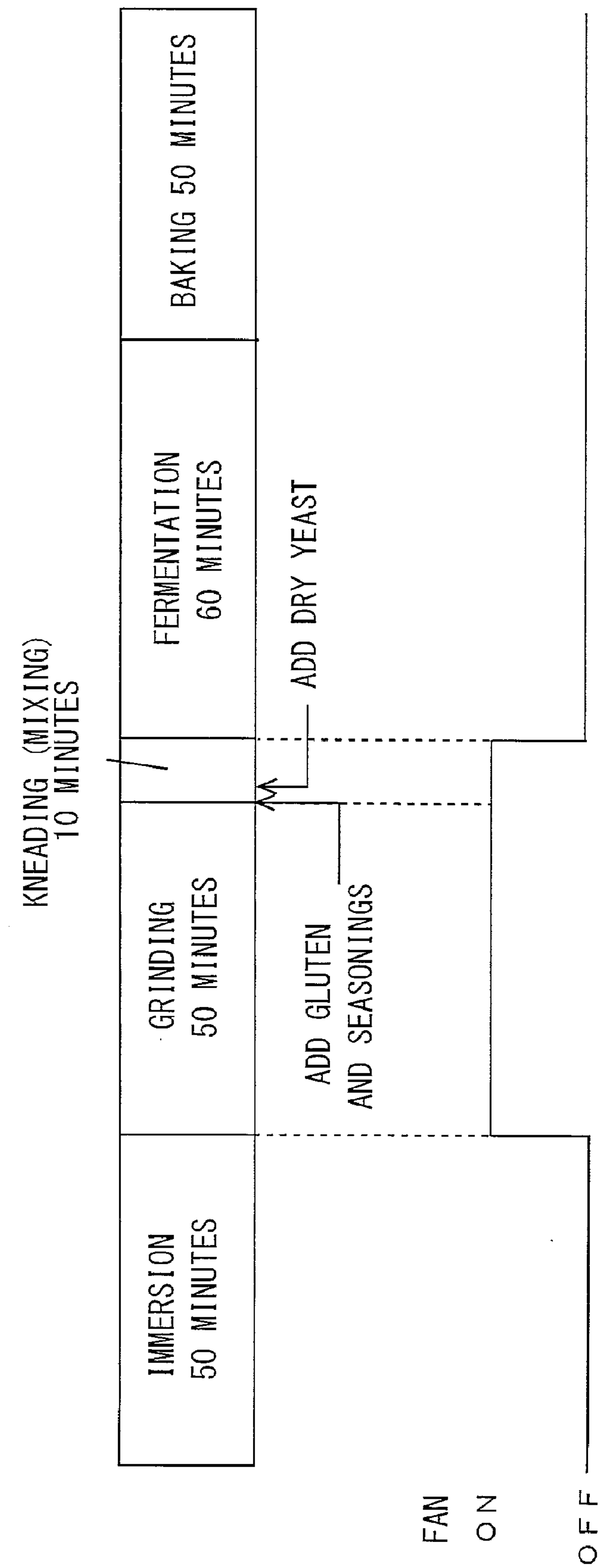


FIG.11



KNEADING MOTOR
50
GRINDING MOTOR
60
SHEATH HEATER
31
SOLENOID
73
FAN
17
KNEADING MOTOR DRIVE CIRCUIT
121
GRINDING MOTOR DRIVE CIRCUIT
122
HEATER DRIVE CIRCUIT
123
SOLENOID DRIVE CIRCUIT
124
FAN MOTOR DRIVE CIRCUIT
125
CONTROL APPARATUS
120
OPERATION PART
20
TEMPERATURE SENSOR
15

FIG.12


IMMERSION 50 MINUTES
GRINDING 50 MINUTES
KNEADING (MIXING) 10 MINUTES
FERMENTATION 60 MINUTES
BAKING 50 MINUTES
ADD GLUTEN AND SEASONINGS
ADD DRY YEAST
FAN
ON
OFF

AUTOMATIC BREAD MAKER

TECHNICAL FIELD

[0001] The present invention relates to an automatic bread maker used mainly in typical households.

BACKGROUND ART

[0002] Automatic bread makers for home use on the market generally have a system to make bread in which a bread container, into which the bread ingredients are put, is used as the baking pan (e.g., refer to Patent Document 1). In such an automatic bread maker, a bread container into which bread ingredients have been put is first introduced into a baking compartment in the body. The bread ingredients in the bread container are subsequently kneaded into a dough using a kneading blade provided in the bread container (kneading step). A fermentation step is then performed to ferment the kneaded dough, and the bread is baked using the bread container as the baking pan (baking step).

[0003] Conventionally, flour (wheat flour, rice flour, and the like) produced by milling a cereal such as wheat and rice, or mixed flour produced by mixing various supplementary ingredients into the milled flour, are required as bread-making ingredients when bread is made using such an automatic bread maker.

LIST OF CITATIONS

Patent Documents

[0004] [Patent Document 1] Japanese Laid-open Patent Application No. 2000-116526

SUMMARY OF INVENTION

Technical Problem

[0005] In typical households, a cereal is sometimes stored in a granular form, as with rice grain, instead of a powdered form. Therefore, it would be extremely convenient if it were possible to make bread directly from cereal grains using an automatic bread maker Accordingly, after diligent study the present applicants have invented a method for making bread using cereal grains as a starting ingredient. The present applicants have already submitted a patent application (Japanese Published Unexamined Application No. 2008-201507).

[0006] The bread-making method for which an application has already been submitted will be introduced. In this bread-making method, cereal grains are first mixed with a liquid, the grinding blade is caused to rotate in the mixture, and the cereal grains are ground (grinding step). Then gluten, yeast and other ingredients, for example, are fed into the paste-form ground flour obtained from the grinding step, and these bread ingredients are kneaded into a dough by a kneading blade (kneading step). After the dough is fermented (fermentation step), the fermented dough is baked into bread (baking step).

[0007] In order to realize an automatic bread maker that can execute these bread-making steps, the present applicants have been involved in developing an automatic bread maker that can execute the grinding step and the kneading step in a single bread container accommodated in the baking compartment. In the grinding step, the grinding blade is caused to rotate at high speed (e.g., 7000 to 8000 rpm) inside the bread container to make ground flour from cereal grains. In the kneading step, the kneading blade is caused to rotate at low speed (e.g., about 180 rpm) inside the bread container and the bread ingredients including the cereal grains ground in the grinding step are kneaded into bread dough.

[0008] During the development of the automatic bread maker, it was found that the temperature of the bread ingredients in the bread container readily increases excessively due to the frictional heat produced by the bearings or the like in the case that the grinding blade has been caused to rotate at high speed, and due to frictional heat between the grinding blade and the cereal grains. In the kneading step performed subsequent to the grinding step, a state in which the temperature of the bread ingredients has increased excessively is not preferred in consideration of causing the yeast to actively work. Therefore, there is a desire for the automatic bread maker being developed to be provided with a system that can inhibit an excessive increase in the temperature of the bread ingredients in the grinding step.

[0009] In view of the foregoing, an object of the present invention is to provide an automatic bread maker that can make bread from cereal grains and that can inhibit an increase in the temperature of the bread ingredients that accompanies the grinding of the cereal grains.

Solution to Problem

[0010] In order to achieve the aforementioned object, an automatic bread maker according to the present invention comprises: a bread container into which bread ingredients are put; a body having an accommodation part for accommodating the bread container; a grinding blade for grinding cereal grains inside the bread container accommodated in the accommodation part; and a duct and fan for creating an airflow for cooling the accommodation part using ventilation holes provided in the accommodation part.

[0011] The automatic bread maker of the present aspect is provided with a grinding blade and is capable of making bread from cereal grains. The automatic bread maker of the present aspect has a configuration further comprising a duct and fan for creating an airflow for cooling the accommodation part. It is possible to inhibit an excessive increase in the temperature of the bread ingredients in the bread container accommodated in the accommodation part in the case that cereal grains are ground using the grinding blade.

[0012] The automatic bread maker of the aspect described above preferably further comprises a first motor provided inside the body in order to cause the grinding blade to rotate. In this aspect, the first motor is driven in the case that cereal grains are to be ground. The first motor causes the grinding blade to rotate at high speed, and frictional heat produced by the bearings or the like by driving the first motor readily increases the temperature of the bread ingredients. In view whereof, in the present aspect, an excessive increase in the temperature of the bread ingredients can be inhibited because a duct and fan are provided for creating an airflow that cools the accommodation part.

[0013] The automatic bread maker of the aspect described above may further comprises a control unit for executing bread-making steps, the bread-making steps including a grinding step for causing the grinding blade to rotate and grind cereal grains inside the bread container into which cereal grains and a liquid have been put, wherein the control unit drives the fan in the case that the grinding step is executed. In accordance with the present aspect, the driving of the fan is controlled by the control unit during the grinding step and is therefore convenient for the user.

[0014] The automatic bread maker of the aspect described above may further comprise: a kneading blade for kneading bread ingredients into bread dough inside the bread container accommodated in the accommodation part; a second motor provided inside the body in order to cause the kneading blade to rotate; a heating part provided to the accommodation part; and a control unit for causing bread-making steps to be executed, the bread-making steps including a grinding step for causing the grinding blade to rotate and grind cereal grains inside the bread container into which cereal grains and a liquid have been put, a kneading step for causing the kneading blade to rotate and knead bread dough inside the bread container into which bread ingredients including ground flour obtained by grinding cereal grains have been put, a fermentation step for causing kneaded bread dough to ferment, and a baking step for baking the fermented bread dough, wherein the control unit drives the fan in the case that at least the grinding step of the bread-making steps is executed.

[0015] In accordance with the present aspect, driving of the fan during at least the grinding step is controlled by the control unit and is therefore convenient for the user.

[0016] The automatic bread maker of the aspect described above may further comprise: a temperature detector for detecting the temperature of the accommodation part; and a control unit for controlling drive of the fan on the basis of temperature information obtained from the temperature detector. Such a configuration makes it possible to drive the fan with suitable timing in consideration of the effect of ambient temperature (e.g., it is possible to drive the fan with suitable timing in the kneading step or the like as well, and not merely in the grinding step). The automatic bread maker of the present aspect can therefore readily make good quality bread.

[0017] In the automatic bread maker of the above-described aspect, the ventilation holes may be formed so that a part of a sidewall of the accommodation part is made to protrude in a direction facing the exterior of the accommodation part. In accordance with the present aspect, it is possible to adopt a configuration in which foreign matter is unlikely to enter from the accommodation part into the interior of the body and the interior of the duct via the ventilation holes. Also, in accordance with present aspect, it is possible to achieve a configuration in which there will be little incidence of matter getting caught or other such events occurring inside the accommodation part because projections are not formed inside the accommodation part.

[0018] In the automatic bread maker of the aspect described above, first ventilation holes and second ventilation holes may be included in the ventilation holes provided to the accommodation part; the accommodation part and the exterior of the body may be in communication via the duct and the second ventilation holes; and the fan may take air from the exterior of the accommodation part into the accommodation part via the first ventilation holes, and exhaust air inside the accommodation part to the exterior of the body via the second ventilation holes and the duct. In accordance with the present aspect, a cooling mechanism using a fan and a duct is readily achieved at low cost.

[0019] In the automatic bread maker of the aspect described above, the first ventilation holes may be formed in a first sidewall of the accommodation part, the second ventilation holes may be formed in a second sidewall of the accommodation part, and the first sidewall and the second sidewall may face each other. In accordance with the present aspect, a configuration is adopted wherein an intake port (first ventilation holes) and an exhaust port (second ventilation holes) are provided so that the bread container accommodated inside the accommodation part is disposed therebetween, and the bread container is readily cooled with good efficiency by the airflow created by the fan.

[0020] In the automatic bread maker of the aspect described above, the fan is preferably provided inside the duct. The present aspect makes it possible to reduce the size of the automatic bread maker. Also, the fan is not exposed on the exterior side, and a safe automatic bread maker can be obtained.

Advantageous Effects of the Invention

[0021] In accordance with the present invention, it is possible to provide an automatic bread maker that can make bread from cereal grains and that can inhibit an increase in the temperature of the bread ingredients that accompanies the grinding of the cereal grains. In other words, in accordance with the present invention, an automatic bread maker provided with a convenient system capable of making bread from cereal grains can be provided, and it can therefore be expected that bread-making at home will become more accessible and popular.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] FIG. **1** is a schematic perspective view showing a configuration of the external appearance of the automatic bread maker according to the present embodiment;

[0023] FIG. **2** is an illustrative diagram showing the configuration inside the body of the automatic bread maker of the present embodiment;

[0024] FIG. **3**A is a diagram illustrating the clutch included in the first power transmission unit provided to the automatic bread maker of the present embodiment, and is a diagram showing the state in which the clutch cuts off power;

[0025] FIG. **3**B is a diagram illustrating the clutch included in the first power transmission unit provided to the automatic bread maker of the present embodiment, and is a diagram showing the state in which the clutch transmits power;

[0026] FIG. **4** is a partial cross-sectional view showing the schematic configuration of the automatic bread maker of the present embodiment;

[0027] FIG. **5** is a view for illustrating a configuration of a grinding blade and a kneading blade provided to the automatic bread maker according to the present embodiment, and is a schematic view observed diagonally from the below;

[0028] FIG. **6** is a view for illustrating the configuration of the grinding blade and the kneading blade provided to the automatic bread maker of the present embodiment, and is a schematic view observed from the bottom;

[0029] FIG. **7** is a top view of the bread container in the automatic bread maker according to the present embodiment when the kneading blade is in the folded orientation;

[0030] FIG. **8** is a top view of the bread container in the automatic bread maker according to the present embodiment when the kneading blade is in the open orientation;

[0031] FIG. **9** is a schematic perspective view showing a configuration of the guard provided to the automatic bread maker of the present embodiment;

[0032] FIG. **10** is a view for illustrating a configuration of the cooling mechanism provided to the automatic bread maker of the present embodiment;

[0033] FIG. **11** is a block diagram showing the configuration automatic bread maker of the present embodiment; and

[0034] FIG. **12** is a schematic view showing the flow of the bread-making steps executed by the rice-grain bread-making procedure.

DESCRIPTION OF EMBODIMENTS

[0035] Embodiments of an automatic bread maker according to the present invention will be described in detail below with reference to the accompanying drawings. It is to be understood that any specific time, temperature, or other parameters that appear in this specification are merely examples and are not intended in any way to limit the content of the invention.

[0036] (Configuration of the Automatic Bread Maker)

[0037] FIG. **1** is a schematic perspective view showing a configuration of the external appearance of the automatic bread maker according to the present embodiment. An operation part **20** is provided on the right side of the upper surface of the body **10** (formed from, e.g., plastic) of the automatic bread maker **1**, as shown in FIG. **1**. The operation part **20** is provided with an operation key group comprising, inter alia, a start key, a cancel key, a timer key, a reservation key, and a selection key for selecting a bread-making procedure; and a display unit for displaying the contents of a setup performed by operating the operation keys, errors, and other data. The bread-making procedures described above includes a procedure for making bread using rice grains as a starting ingredient, a procedure for making bread using rice flour as a starting ingredient, a procedure for making bread using wheat flour as a starting ingredient, and other procedures. Also, the display unit is composed of, e.g., a liquid crystal display panel, and indicator lamps using light emitting diodes as light sources.

[0038] A baking compartment **30** (an embodiment of the accommodation part of the present invention) for accommodating the bread container (described in detail below) is formed in the body **10** so as to be adjacent to the operation part **20** (next to the left side thereof in FIG. **1**). The baking compartment **30** made of, e.g., sheet metal is formed in substantially a rectangular shape as view from above, has a bottom wall **30***a* and four sidewalls **30***b* (refer also to FIG. **4** described below), and has an open upper surface. A lid **40** (made of, e.g., plastic) for covering the baking compartment **30** is provided to the body **10**. The lid **40** is mounted on the back surface of the body **10** using a hinge (not shown). The lid **40** is swung about the hinge as a support point, whereby the aperture of the baking compartment **30** can be opened and closed. The lid **40** is provided with an observation window (not shown) made of, e.g., heat-resistant glass to allow the user to view the baking compartment **30**.

[0039] FIG. **2** is an illustrative diagram showing the configuration inside the body of the automatic bread maker of the present embodiment. FIG. **2** envisions the case in which the automatic bread maker **1** is viewed from above. A low-speed, high-torque kneading motor **50** used in the kneading step is secured and disposed to the right of the baking compartment **30** in the automatic bread maker **1**, as shown in FIG. **2**. A high-speed-rotation grinding motor **60** used in the grinding step is disposed and secured behind the baking compartment **30** in the automatic bread maker **1**. The kneading motor **50** and the grinding motor **60** both have vertically oriented shafts. The kneading motor **50** is an embodiment of the second motor of the present invention, and the grinding motor **60** is an embodiment of the first motor of the present invention.

[0040] A first pulley **52** is secured to an output shaft **51** that protrudes from the upper surface of the kneading motor **50**. The first pulley **52** is connected to a second pulley **55** by a first belt **53**. The second pulley **55** is formed having a greater diameter than the first pulley **52** and is secured to the upper side of the first rotating shaft **54**. A second rotating shaft **57** is provided to the lower side of the first rotating shaft **54** so that the rotational center is substantially the same as that of the first rotating shaft **54**. The first rotating shaft **54** and the second rotating shaft **57** are rotatably supported inside the body **10**. A clutch **56** for transmitting and interrupting power is provided between the first rotating shaft **54** and the second rotating shaft **57**. The configuration of the clutch **56** will be described later.

[0041] A third pulley **58** is secured to the lower side of the second rotating shaft **57**. The third pulley **58** is connected to a first motor shaft pulley **12** (having substantially the same diameter as the third pulley **58**) by a second belt **59**. The first motor shaft pulley **12** is secured to a motor shaft **11** which is provided to the lower side of the baking compartment **30**. The kneading motor **50** is a low-speed, high-torque motor, and the rotation of the first pulley **52** thereabove is reduced by the second pulley **55** (e.g., reduced to ⅕ speed). Accordingly, the motor shaft **11** rotates at low speed when the kneading motor **50** is driven in a state in which the clutch **56** is transmitting power.

[0042] The power transmission unit configured using the first pulley **52**, the first belt **53**, the first rotating shaft **54**, the second pulley **55**, the clutch **56**, the second rotating shaft **57**, the third pulley **58**, the second belt **59**, and the first motor shaft pulley **12** is at times referred to below as a first power transmission unit. The first power transmission unit connects the motor shaft **11** and the output shaft **51** of the kneading motor **50** in a power-transmission-enabled manner in a state in which the clutch **56** is performing power transmission.

[0043] A fourth pulley **62** is secured to an output shaft **61** that protrudes from the lower surface of the grinding motor **60**. The fourth pulley **62** is connected to a second motor shaft pulley **13** (secured further below the first motor shaft pulley **12**) which is secured to the motor shaft **11** by a third belt **63**. The second motor shaft pulley **13** has substantially the same diameter as the fourth pulley **62**. A high-speed motor is selected as the grinding motor **60** and the rotation of the fourth pulley **62** is kept at substantially the same speed as the second motor shaft pulley **13**. Accordingly, the motor shaft **11** rotates at high speed (e.g., 7000 to 8000 rpm) when the grinding motor **60** is driven.

[0044] The power transmission unit composed of the fourth pulley **62**, the third belt **63**, and the second motor shaft pulley **13** may hereinbelow be referred to as a second power transmission unit. The second power transmission unit is of a clutchless configuration, and the motor shaft **11** and the output shaft **61** of the grinding motor **60** are connected so as to allow constant power transmission.

[0045] FIGS. **3**A and **3**B are diagrams illustrating the clutch included in the first power transmission unit provided to the automatic bread maker of the present embodiment. FIGS. **3**A and **3**B are views of the first power transmission unit as viewed along the A direction of the arrow in FIG. **2**. FIG. **3**A shows the state in which the clutch **56** cuts off power, and FIG. **3**B shows the state in which the clutch **56** transmits power.

[0046] The clutch **56** has a first clutch member **561** and a second clutch member **562**, as shown in FIGS. **3**A and **3**B. The clutch **56** transmits power in the case that a pawl **561***a* provided to the first clutch member **561** meshes with a pawl **562***a* provided to the second clutch member **562** (the state shown in FIG. **3**B). The clutch **56** cuts off power in the case the two pawls **561***a*, **562***b* do not mesh together (the state shown in FIG. **3**A). In other words, the clutch **56** is a meshing clutch.

[0047] In the present embodiment, six pawls **561***a*, **562***a* aligned in the peripheral direction in substantially equidistant intervals are provided to the two clutch members **561**, **562**, but the number of pawls can be suitably modified. Here, the peripheral direction refers to the case in which the first clutch member **561** is viewed from below and the case in which the second clutch member **562** is viewed from above. An advantageous shape of the pawls **561***a*, **562***a* can be suitably selected.

[0048] The first clutch member **561** is retainably arranged, the first clutch member **561** being capable of sliding in the axial direction (the vertical direction in FIGS. **3**A and **3**B) of the first rotating shaft **54**, and being mounted thereon so as to be incapable of rotation. A spring **71** is loosely fitted on the upper side of the first clutch member **561** in the first rotating shaft **54**. The spring **71** is arranged so as to be sandwiched between the first clutch member **561** and a stopper **54***a* provided to the first rotating shaft **54**, and so as to urge the first clutch member **561** downward. The second clutch member **562** is secured to the upper end of the second rotating shaft **57**.

[0049] Switching (switching between a power transmission state and a power cutoff state) of the clutch **56** is carried out using an arm part **72** disposed below the first clutch member **561** and movably provided in the vertical direction (axial direction of the first rotating shaft **54**), and a self-holding solenoid **73** in which a permanent magnet **73***a* is housed. The distal end part (corresponding to the lower side in FIGS. **3**A and **3**B) of a plunger **73***b* of the solenoid **73** is secured to the mounting part **72***a* provided to the arm part **72**. The arm part **72** (including the mounting part **72***a*) is formed using metal and can therefore chuck to the permanent magnet **73***a*.

[0050] The force by which the permanent magnet **73***a* chucks the arm part **72** (more precisely, the mounting part **72***a*) is reduced when voltage is applied to the solenoid **73** so as to cancel the magnetic field of the permanent magnet **73***a* from the state shown in FIG. **3**A. The first clutch member **561** is pressed downward by the urging force of the spring **71**. Meshing is thereby obtained between the pawl **561***a* of the first clutch member **561** and the pawl **562***a* of the second clutch member **562**, and the clutch **56** transmits power (achieving the state shown in FIG. **3**B). The state in which this meshing has been achieved is maintained by the urging force of the spring **71**, the driving for bringing the first clutch member **561** downward is therefore carried out, and the solenoid **73** is switched off. In this state in which meshing has been achieved, the arm part **72** is lowered and the plunger **73***b* of the solenoid **73** is therefore in a state in which the protruding distance (downward protruding distance) from a housing **73***c* has been increased.

[0051] On the other hand, when voltage is applied to the solenoid **73** in a direction that lifts the plunger **73***b* from the state shown in FIG. **3**B (voltage in the direction opposite from the direction for canceling the magnetic field of the permanent magnet **73***a*), the first clutch member **561** is lifted upward together with the arm part **72** against the urging force of the spring **71**. Meshing is thereby released between the pawl **561***a* of the first clutch member **561** and the pawl **562***a* of the second clutch member **562**, and the clutch **56** cuts off power (achieving the state shown in FIG. **3**A). In a state in which this meshing has been released, the permanent magnet **73***a* housed in the solenoid **73** chucks the arm part **72** (more precisely, the mounting part **72***a*). Therefore, after the driving for lifting the first clutch member **561** has been carried out, the state in which the meshing has been release can be maintained even if the solenoid **73** is switched off, and the solenoid **73** is then switched off.

[0052] In the case that the grinding motor **60** is to be driven, the rotary power for causing the motor shaft **11** to rotate at high speed is transmitted to the output shaft **51** of the kneading motor **50** when the clutch **56** is in a power-transmitting state (the state shown in FIG. **3**B). In this case, a force for causing the output shaft **51** of the kneading motor **50** to rotate at 40,000 rpm is required in accordance with the radius ratio between the first pulley **52** and the second pulley **55** (e.g., 1:5) when the grinding motor **60** is to be caused to rotate at, e.g., 8000 rpm. As a result, the grinding motor **60** may be damaged because an extremely high load is imparted to the grinding motor **60**. The rotary power for causing the motor shaft **11** to rotate at high speed must be kept from being transmitted to the output shaft **51** of the kneading motor **50** when the grinding motor **60** is driven, and the automatic bread maker **1** therefore has a configuration that includes the clutch **56** for performing power transmission and power cutoff in the first power transmission unit.

[0053] As described above, the automatic bread maker has a configuration in which a clutch is not provided to the second power transmission unit, which is composed of the fourth pulley **62**, the third belt **63**, and the second motor shaft pulley **13**. However, even with such a configuration, a high load such as that described above is not applied to the kneading motor **50** and motor damage does not occur. This is due to the fact that the motor shaft **11** is rotated merely at low speed (e.g., 180 rpm) even when the kneading motor **50** is driven, and a high load is not applied to the kneading motor **50** even if the rotary power for causing the motor shaft **11** to rotate is transmitted to the output shaft of the grinding motor **60**. Also, the cost of manufacturing the automatic bread maker is reduced by using a configuration in which a clutch is not specially provided to the second power transmission unit in this manner.

[0054] In the automatic bread maker **1** of the present embodiment, the clutch **56** is a meshing clutch, but the present invention shall not be construed to be limited thereby; in some cases, it is also possible to use an electromagnetic clutch or the like in place of a meshing clutch.

[0055] FIG. **4** is a partial cross-sectional view showing the schematic configuration of the automatic bread maker of the present embodiment. FIG. **4** envisions the case in which the automatic bread maker is viewed from the front. In FIG. **4**, the bread container **80** into which bread ingredients have been put is shown in a state accommodated in the baking compartment **30**. A sheath heater **31** (an embodiment of the heating part of the present invention) is disposed inside the baking compartment **30** so as to surround the bread container **80** accommodated in the baking compartment **31**, as shown in FIG. **4**. The bread ingredients inside the bread container **80** can thereby be heated.

[0056] A bread container support **14** (made of, e.g., a die-cast article molded from an aluminum alloy) for supporting the bread container **80** is secured at a location corresponding substantially to the center of the bottom wall **30***a* of the baking compartment **30**. The bread container support **14** is formed so as to be depressed from the bottom wall **30***a* of the baking compartment **30**, and the shape of the depression is substantially circular as viewed from above. The motor shaft **11** is supported in the center of the bread container support **14** so as to be substantially vertical with respect to the bottom wall **30***a*.

[0057] The bread container **80** is, e.g., a die-cast molding of an aluminum alloy. The bread container **80** has the shape of a bucket and a handle (not shown) for gripping is mounted on a flange part **80***a* provided to edge of the aperture of the bread container. The horizontal cross-section of the bread container **80** is a rectangle with four rounded corners. A recess **81** having a substantially circular shape as viewed from above is formed in the bottom part of the bread container **80** to accommodate a grinding blade **90** (described in detail hereafter) and a cover **100**.

[0058] A vertically extending blade rotation shaft **82** is rotatably supported in a sealed state at the center of the bottom part of the bread container **80**. A container-side coupling member **82***a* is secured to the lower end of the blade rotation shaft **82** (the lower end protrudes from the bottom part of the bread container **80**). A cylindrical pedestal **83** is provided to the exterior surface side of the bottom part of the bread container **80**, and the bread container **80** is designed to be accommodated in the baking compartment **30** in a state in which the pedestal **83** is received by the bread container support **14**. The pedestal **83** may be formed separately from the bread container **80** or may be integrally formed with the bread container **80**.

[0059] Projections (not shown) are formed on the internal circumferential surface of the bread container support **14** and the external circumferential surface of the pedestal **83**, and these projections constitute a known bayonet coupling. In other words, when the bread container **80** is to be mounted on the bread container support **14**, the projections on the pedestal **83** are kept from interfering with the projections on the bread container support **14**, and the bread container **80** is lowered thereon. After the pedestal **83** is fitted into the bread container support **14**, the projections of the pedestal **83** are designed to engage with the lower surfaces of the projections of the bread container support **14** when the bread container **80** twists horizontally. The bread container **80** is thereby prevented from slipping out upwards.

[0060] With this operation, the connecting (coupling) of the above-described container-side coupling member **82***a* provided to the lower end of the blade rotation shaft **82** and a motor shaft-side coupling member **11***a* secured to the upper end of the motor shaft **11** is also achieved at the same time. This coupling makes it possible for rotary power from the motor shaft **11** to be transmitted to the blade rotation shaft **82**.

[0061] The grinding blade **90** is mounted on the blade rotation shaft **82** at a location slightly above the bottom of the bread container **80**. A dome-shaped cover **100** having a substantially circular shape as viewed from above is mounted on the upper end of the blade rotation shaft **82**. FIG. **5** is a view for illustrating a configuration of a grinding blade and a kneading blade provided to the automatic bread maker of the present embodiment, and is a schematic view observed diagonally from the below. FIG. **6** is a view for illustrating a configuration of a grinding blade and a kneading blade provided to the automatic bread maker of the present embodiment, and is a schematic view observed from the below.

[0062] The grinding blade **90** (formed from, e.g., a stainless steel plate) has a shape similar to an aircraft propeller and is mounted so as to be incapable of rotation in relation to the blade rotation shaft **82**, as shown in FIGS. **5** and **6**. The center part of the grinding blade **90** is a hub **90***a* that fits onto the blade rotation shaft **82**. A groove **90***b* is formed in the lower surface of the hub **90***a* so as to traverse the hub **90***a* in the diameter direction. In the case that the grinding blade **90** is fitted onto the blade rotation shaft **82** from above, a pin (not shown) that passes through the blade rotation shaft **82** in the horizontal direction receives the hub **90***a* and engages the groove **90***b*. The grinding blade **90** is connected mounted to the blade rotation shaft **82** so as to be unable to rotate.

[0063] The grinding blade **90** is configured so that it can be readily pulled away and separated from the blade rotation shaft **82**, and can therefore be cleaned after bread making and can be readily replaced when the edge thereof becomes dull.

[0064] A dome-shaped cover **100** (made of, e.g., a die-cast molding of an aluminum alloy) surrounds, covers, and hides the grinding blade **90**, as shown in FIG. **5**. The cover **100** is rotatably supported by the hub **90***a* of the grinding blade **90** and is retained on the hub **90***a* by a washer **100***a* and a retaining ring **100***b* (refer to FIG. **4**). In other words, in the present embodiment, the grinding blade **90** and the cover **100** constitute an inseparable unit. The hub **90***a* of the grinding blade **90** is configured so as to double as a rotating shaft receiving part for receiving the blade rotation shaft **82** in the cover **100**.

[0065] The cover **100** can be easily pulled away from the blade rotation shaft **82** together with the grinding blade **90**, enabling cleaning to be readily performed after making bread.

[0066] A kneading blade **102** (made of, e.g., a die-cast molding of an aluminum alloy), whose planar shape is a sideways V, is mounted on the exterior surface of the dome-shaped cover **100**, and is mounted on a support shaft **101** (refer to FIG. **6**) that extends in the vertical direction in a location set at a distance from the blade rotation shaft **82**. The support shaft **101** is fixed to or integrated with the kneading blade **102** and moves with the kneading blade **102**.

[0067] In the present embodiment, a complementary kneading blade **103** is provided to the exterior surface of the cover **100** so as to align with the kneading blade **102**. The complementary kneading blade **103** is not necessarily required, but is preferably provided in order to increase efficiency in the kneading step for kneading bread dough. In the case of the present configuration, the kneading blade **102** and the complementary kneading blade **103** are an embodiment of the kneading blade of the present invention.

[0068] The operation of the kneading blade **102** will be described with reference to FIGS. **5** to **8**. FIGS. **7** and **8** are a view of the bread container **80** as seen from above, and the kneading blade **102** has a different orientation in FIGS. **7** and **8**.

[0069] The kneading blade **102** rotates together with the support shaft **101** about the axis of the support shaft **101**, and has two orientations: the folded orientation shown in FIG. **7**, and the open orientation shown in FIG. **8**. In the folded orientation, a projection **102***a* (refer to FIG. **5**) suspended downward from the lower edge of the kneading blade **102** is in contact with a first stopper **100***c* provided to the upper surface of the cover **100**. Accordingly, in the folded orientation, the kneading blade **102** cannot swing further in the clockwise direction (when viewed from above) in relation to the cover **100**. At this time, the tip of the kneading blade **102** protrudes slightly from the cover **100**. When the kneading blade **102** swings from this orientation in the counterclockwise direction (as viewed from above) and achieves the orientation shown in FIG. **8**, the distal end of the kneading blade **102** protrudes considerably from the cover **100**. The open angle of the kneading blade **102** in the open orientation is limited by a second stopper **100***d* (refer to FIGS. **5** and **6**) provided to the interior surface of the cover **100**. The kneading blade **102** is at the maximum open angle when a second engaging body **104***b* (which is securely mounted on the support shaft **101**) constituting a later-described cover clutch **104** (refer to FIG. **6**) makes contact with the second stopper **100***d* and can no longer rotate.

[0070] In the case that the kneading blade **102** is in the folded orientation, the complementary kneading blade **103** is aligned with the kneading blade **102** as shown in FIG. **7**, and the size of the kneading blade **102** essentially having the shape of a sideways V is increased.

[0071] As shown in FIG. **6**, the cover clutch **104** is interposed between the cover **100** and the blade rotation shaft **82**. The cover clutch **104** connects the blade rotation shaft **82** and the cover **100** in the rotation direction of the blade rotation shaft **82** when the kneading motor **50** causes the motor shaft **11** to rotate (this rotation direction is the "forward direction," and is the clockwise direction in FIG. **6**). Conversely, the cover clutch **104** disconnects the blade rotation shaft **82** from the cover **100** in the rotation direction of the blade rotation shaft **82** when the grinding motor **60** causes the motor shaft **11** to rotate (this rotation direction is the "reverse direction," and is the counter-clockwise direction in FIG. **6**). In FIGS. **7** and **8**, the "forward direction rotation" is the counter-clockwise direction rotation and the "reverse direction rotation" is the clockwise direction rotation.

[0072] The cover clutch **104** will be described in further detail. The cover clutch **104** is composed of a first engaging body **104***a* and the second engaging body **104***b*. The first engaging body **104***a* is secured to the hub **90***a* of the grinding blade **90** or is integrally formed with the hub **90***a*. In other words, the grinding blade **90** is mounted on the blade rotation shaft **82** and the first engaging body **104***a* is mounted on the blade rotation shaft **82** so as to be unable to rotate. The second engaging body **104***b* is secured to the support shaft **101** of the kneading blade **102** or integrally formed with the support shaft **101**, and varies in angle in accompaniment with the change in orientation of the kneading blade **102**.

[0073] In the case that the kneading blade **102** is in the folded orientation (e.g., the state of FIGS. **6** and **7**), the second engaging body **104***b* is at an angle that interferes with the rotation trajectory of the first engaging body **104***a*. Therefore, the first engaging body **104***a* and the second engaging body **104***b* engage when the blade rotation shaft **82** rotates in the forward direction (rotation in the clockwise direction in FIG. **6**, and rotation in the counter-clockwise direction in FIG. **7**), and the rotary force of the blade rotation shaft **82** is transmitted to the cover **100** and the kneading blade **102**.

[0074] On the other hand, in the case that the kneading blade **102** is in the open orientation (the state of FIG. **8**), the second engaging body **104***b* is at an angle that does not interfere with the rotation trajectory of the first engaging body **104***a*. Therefore, even when the blade rotation shaft **82** rotates in the reverse direction (rotation in the clockwise direction in FIG. **8**), the first engaging body **104***a* and the second engaging body **104***b* do not engage with each other. The rotary force of the blade rotation shaft **82** accordingly is not transmitted to the cover **100** and the kneading blade **102**. It is apparent from the above that the cover clutch **104** switches the connection state between the blade rotation shaft **82** and the cover **100** using the orientation of the kneading blade **102**.

[0075] A window **105** that provides communication between the interior space of the cover and the exterior space of the cover is formed in the cover **100**, as shown in FIGS. **5** and **6**. The window **105** is disposed at the same height as the grinding blade **90** or in a position thereabove. In the present embodiment, four windows **105** are arranged at 90° intervals, but any number and arrangement interval may be used.

[0076] Also, four ribs **106** are formed in corresponding fashion to the windows **105** on the interior surface of the cover **100**. The ribs **106** extend diagonally in the radial direction from near the center of the cover **100** to the annular wall of the external periphery, and the four ribs together constitute a type of spiral shape. The ribs **106** curve so that the sides facing the bread ingredients, which are pressed toward the ribs, are convex.

[0077] Returning to FIG. **4**, a guard **110** is detachably mounted on the lower surface of the cover **100**. The guard **110** covers the lower surface of the cover **100** and blocks the user's finger from coming near the grinding blade **90**. The guard **110** is formed from, e.g., a heat resistant engineering plastic and is a molded article composed of, e.g., polyphenylene sulfide (PPS) or the like. FIG. **9** is a schematic perspective view showing a configuration of the guard provided to the automatic bread maker of the present embodiment.

[0078] A ring-shaped hub **111** for passing the blade rotation shaft **82** is provided in the center of the guard **110**, as shown in FIG. **9**. A ring-shaped rim **112** is provided to the peripheral edge of the guard **110**. The hub **111** and the rim **112** are connected by a plurality of spokes **113**. The spaces between the spokes **113** constitute an aperture part **114** for passing rice grains ground by the grinding blade **90**. The size of the aperture part **114** is such that a finger cannot pass through.

[0079] The guard **110** is proximate to the grinding blade **90** when the guard has been mounted on the cover **100**. The guard **110** has the appearance of an outer blade of a rotary electric shaver and the grinding blade **90** has the appearance of an inner blade.

[0080] Four columns **115** (no limitation is imposed on the number thereof, as shall be apparent) are integrally molded at 90° intervals at the peripheral edge of the rim **112**. A horizontal groove **115***a* with a terminus at one end is formed on the side surface facing the center side of the guard **110** of the columns **115**. Projections **100***e* (eight of these also are disposed at 45° intervals in the present embodiment) formed on the external periphery of the cover **100** engage the groove **115***a*, whereby the guard **110** is mounted on the cover **100**. The groove **115***a* and the projections **100***e* are provided so as to constitute a bayonet coupling.

[0081] FIG. **10** is a view for illustrating a configuration of the cooling mechanism provided to the automatic bread maker of the present embodiment. FIG. **10** is a schematic cross-sectional view of the case in which the automatic bread maker **1** is viewed from the side surface, and shows the case in which the bread container **80** is not accommodated in the baking compartment **30**. In FIG. **10**, the left side of the diagram corresponds to the front surface side of the automatic bread maker **1**, and the right side of the diagram corresponds to the rear surface side of the automatic bread maker **1**.

[0082] A plurality of first ventilation holes **32** are formed in alignment in the depth direction in the front sidewall **30***bf* (an embodiment of the first sidewall of the present invention) of the baking compartment **30**, as shown in FIG. **10** (refer also to FIG. **2**). The first ventilation holes **32** are obtained by performing work in which a part of the front sidewall **30***bf* made of sheet metal is made to protrude in a direction facing the exterior of the baking compartment **30** (the left-side direction of FIG. **10**). The first ventilation holes **32** are formed so that the upper part side of the portion protruding to the exterior of the baking compartment **30** is open, and a configuration is achieved wherein an air channel connecting to the interior of the baking compartment **30** is formed facing diagonally downward from the opening (diagonally downward to the right in FIG. **10**).

[0083] A plurality of second ventilation holes **33** are formed in alignment in the depth direction in the rear sidewall **30***bb* (an embodiment of the second sidewall of the present invention) facing the front sidewall **30***bf*, as shown in FIG. **10** (refer also to FIG. **2**). In the present embodiment, the number of second ventilation holes **33** is the same as the number of first ventilation holes **32**, but the number is not required to be the same as the number of first ventilation holes **32**. The second ventilation holes **33** are obtained by performing work in which a part of the rear sidewall **30***bb* made of sheet metal is made to protrude in a direction facing the exterior of the baking compartment **30** (the right-side direction of FIG. **10**). The second ventilation holes **33** are formed so that the upper part side of the portion protruding to the exterior of the baking compartment **30** is open, and a configuration is achieved wherein an air channel connecting to the interior of the baking compartment **30** is formed facing diagonally downward from the opening (diagonally downward to the left in FIG. **10**).

[0084] In the body **10**, one end part of an angular duct **16** is mounted on the rear sidewall **30***bb*. The second ventilation holes **33** formed on the rear sidewall **30***bb* of the baking compartment **30** are covered and hidden from the exterior side of the baking compartment **30** by one end part of the angular duct **16**. The other end part of the duct **16** is mounted on the body **10** so as to cover and hide a plurality of slit parts **10***a* from the interior side of the body **10**, the slit parts **10***a* being provided to the back surface of the body **10**. The duct **16** provided in this manner is configured to provide communication between the baking compartment **30** and the exterior of the body **10** via the second ventilation holes **33** and the slit parts **10***a*.

[0085] An axial-flow fan **17** is mounted inside the duct **16** in a position near the slit parts **10***a*. When the fan **17** is driven, air is taken from the exterior of the baking compartment **30** into the baking compartment **30** via the first ventilation holes **32**, and air inside the baking compartment **30** is exhausted to the exterior of the body **10** via the second ventilation holes **33** and the duct **16**, as shown by the broken arrow in FIG. **10**. In other words, an air flow is created in which air (that is cooler than inside the baking compartment **30**) is taken from the exterior of the baking compartment **30** to the interior thereof by the driving of the fan **17**, the air inside the baking compartment **30** (heated by frictional heat) is exhausted to the exterior of the body **10**, and the interior of the baking compartment **30** is cooled.

[0086] The number and position of the first ventilation holes **32** and the second ventilation holes **33** shall not be construed to be limited to the configuration of the present embodiment. The number and position may be suitably modified so that the bread container **80** accommodated in the baking compartment **30** can be cooled with good efficiency. In the present embodiment, the positions in which the first ventilation holes **32** and the second ventilation holes **33** are formed are the mutually opposing sidewalls **30***bf*, **30***bb*. A configuration is thereby adopted wherein an intake port (first ventilation holes **32**) and an exhaust port (second ventilation holes **33**) are provided so that the bread container **80** accommodated inside the baking compartment **30** is disposed therebetween, and the bread container **80** can be cooled with good efficiency by the airflow created by the fan **17**.

[0087] In the automatic bread maker **1** of the present embodiment, the first ventilation holes **32** and the second ventilation holes **33** are obtained by performing work in which parts of the sidewalls **30***bf*, **30***bb* are made to protrude in a direction facing the exterior of the baking compartment **30**. However, the present invention shall not be construed to be limited to this configuration. For example, the first ventilation holes **32** and the second ventilation holes **33** may obtained by performing work in which parts of the sidewalls **30***bf*, **30***bb* are made to protrude in a direction facing the interior of the baking compartment **30**. However, the configuration of the present embodiment is preferred in that it is possible obtain a structure in which foreign matter is less liable to enter into the duct **16** and the interior of the body **10** from the baking compartment **30**. The configuration of the present embodiment is preferred in that there are no projections inside the baking compartment **30**, and there will be little incidence of matter getting caught or other such events occurring inside the baking compartment **30**. The first ventilation holes **32** and the second ventilation holes **33** may be holes opened by a drill or the like in the sidewalls **30***bf*, **30***bb*.

[0088] In the automatic bread maker **1** of the present embodiment, a fan **17** is provided inside the duct **16**, but it is apparent that a cooling fan can also be mounted to the exterior of one end of the duct **16**.

[0089] FIG. **11** is a block diagram showing the configuration of the automatic bread maker of the present embodiment. A control apparatus **120** controls the operation of the automatic bread maker **1**, as shown in FIG. **11**. The control apparatus **120** is configured using, for example, a microcomputer composed of a central processing unit (CPU), read only memory (ROM), random access memory (RAM), input/output (I/O) circuitry, and other components. The control apparatus **120** is preferably disposed in a position unlikely to be affected by the heat of the baking compartment **30**. Further, the control apparatus **120** comprises a time measurement function, making it possible to perform time control in the bread-making step. The control apparatus **120** is an embodiment of the control unit of the present invention.

[0090] Electrically connected to the control apparatus **120** are the above-described operation part **20**, a temperature sensor **15** for detecting the temperature of the baking compartment **30**, a kneading motor drive circuit **121**, a grinding motor drive circuit **122**, a heater drive circuit **123**, a solenoid drive circuit **124**, and a fan motor drive circuit **125**.

[0091] The kneading motor drive circuit **121** is a circuit for controlling the driving of the kneading motor **50** under instruction from the control apparatus **120**. The grinding motor drive circuit **122** is a circuit for controlling the driving of the grinding motor **60** under instruction from the control apparatus **120**. The heater drive circuit **123** is a circuit for controlling the operation of the sheath heater **31** under instruction from the control apparatus **120**. The solenoid drive circuit **124** is a circuit for controlling the driving of the solenoid **73** (refer to FIGS. **3**A and **3**B) for switching the state of the clutch **56** (refer to FIGS. **3**A and **3**B) under instruction from the control apparatus **120**. The fan motor drive circuit **125** is a circuit for controlling the driving of the fan **17** (refer to FIG. **10**) under instruction from the control apparatus **120**.

[0092] The control apparatus **120** reads a program related to the procedure for making bread (bread-making procedure) stored in ROM or the like on the basis of an input signal from the operation part **20**. The control apparatus **120** causes a bread-making procedure to be executed in the automatic bread maker **1** while controlling the rotating of the kneading blade **102** and the complementary kneading blade **103** carried out by the kneading motor **50** via the kneading motor drive circuit **121**, controlling the rotating of the grinding blade **90**

carried out by the grinding motor **60** via the grinding motor drive circuit **122**, controlling the heating operation carried out by the sheath heater **31** via the heater drive circuit **123**, controlling the switching of the clutch **56** by the solenoid **73** via the solenoid drive circuit **124**, and controlling the cooling operation by the fan **17** via the fan motor drive circuit **125**.

[0093] [Operation of the Automatic Bread Maker]

[0094] Next, the operation of the automatic bread maker **1** will be described for the case in which bread is made by the automatic bread maker **1** configured in the manner described above. Here, the operation of the automatic bread maker **1** will be described using as an example the case in which bread is made by the automatic bread maker **1** using rice grains as a starting ingredient.

[0095] The bread-making procedure for rice grains is selected in the case that rice grains are used as the starting ingredient. FIG. **12** is a schematic view showing the flow of the bread-making steps executed by the rice-grain bread-making procedure. In the rice-grain bread-making procedure, the following steps are sequentially performed in the following order: an immersion step, a grinding step, a kneading (mixing) step, a fermentation step, and a baking step, as shown in FIG. **12**. FIG. **12** also shows the operating state of the fan **17** so as to facilitate understanding of the operation of the cooling mechanism for cooling the baking compartment **30**.

[0096] A user mounts the grinding blade **90** and the cover **100**, on which the kneading blade **102** and the complementary kneading blade **103** are attached, on the blade rotation shaft **82** of the bread container **80** when bread is to be made using the rice-grain bread-making procedure. The user then measures the respective predetermined amounts of rice grains and water and puts them in the bread container **80**. Here, rice grains and water are mixed, but a liquid having a taste component such as a soup stock, fruit juice, a liquid containing alcohol, or another liquid, for example, may be used in place of plain water. The user inserts the bread container **80**, into which the rice grains and water have been put, into the baking compartment **30**, closes the lid **40**, selects a rice-grain bread-making procedure by operating the operation part **20**, and presses the start key. The rice-grain bread-making procedure for making bread using rice grains as a starting ingredient is thereby started by the control apparatus **120**.

[0097] When the rice-grain bread-making procedure is started, the immersion step is started by instruction from the control apparatus **120**. In the immersion step, the mixture of rice grains and water is left in a stationary state, and the stationary state is maintained for a predetermined time (**50** minutes in the present embodiment) set in advance. In the immersion step, the rice grains get soaked with water, which is performed to facilitate the grinding of the rice grains to the cores in the grinding step performed subsequently.

[0098] The water-absorption speed of the rice grains varies with the water temperature. That is, the water-absorption speed increases with a high water temperature and decreases with a low water temperature. Accordingly, the time of the immersion step may be varied in accordance with, e.g., the ambient temperature in which the automatic bread maker **1** is used and other parameters. Variability in the water absorption of the rice grains can thereby be minimized. It is possible to energize the sheath heater **31** during the immersion step to increase the temperature of the baking compartment **30** in order to shorten the immersion time.

[0099] In the immersion step, the grinding blade **90** may be caused to rotate in the initial stage and the grinding blade **90** may be caused to rotate intermittently thereafter. Such a configuration makes it possible to scar the surfaces of the rice grains, improving the liquid-absorption efficiency of the rice grains.

[0100] When the above-noted predetermined time has elapsed, the immersion step is ended and the grinding step for grinding the rice grains is started by instruction from the control apparatus **120**. In the grinding step, the grinding blade **90** is rotated at high speed in the mixture of rice grains and water. Specifically, the control apparatus **120** controls the grinding motor **60**, rotating the blade rotation shaft **82** in the reverse direction and starting the grinding blade **90** rotating in the mixture of rice grains and water.

[0101] In the case that the grinding blade **90** is to be rotated using the grinding motor **60**, the control apparatus **120** drives the solenoid **73** to cause the clutch **56** to cut off power (the state shown in FIG. 3A). As described above, the motor may be damaged if this control is not performed. The control apparatus **120** drives the fan **17** when the grinding step is started (refer to FIG. **12**). This is performed to prevent the temperature of the bread ingredients (cereal grains (flour) and water) in the bread container **80** from increasing excessively in the grinding step.

[0102] In the case that the blade rotation shaft **82** has been caused to rotate in the reverse direction in order to cause the grinding blade **90** to rotate, the cover **100** also begins to rotate in accompaniment with the rotation of the blade rotation shaft **82**; however, the rotation of the cover **100** will be immediately inhibited by an operation such as that described below. The rotation direction of the cover **100** accompanying the rotation of the blade rotation shaft **82** for rotating the grinding blade **90** is clockwise in FIG. **7**, and, in a case that the kneading blade **102** has been in the folded orientation (the orientation shown in FIG. **7**), the kneading blade **102** is changed to the open orientation (the orientation shown in FIG. **8**) by resistance from the mixture of the rice grains and water. When the kneading blade **102** moves to the open orientation, the second engaging body **104***b* departs from the rotation trajectory of the first engaging body **104***a*, and therefore the cover clutch **104** disconnects the blade rotation shaft **82** from the cover **100**. At the same time, the kneading blade **102** in the open orientation hits the inner wall of the bread container **80** as shown in FIG. **8**, inhibiting the rotation of the cover **100**.

[0103] In the grinding step, the rice grains are ground in a state in which water has permeated the rice grains by the preceding immersion step, and therefore the rice grains can be readily ground to their cores. Rotation of the grinding blade **90** in the grinding step is intermittent in the present embodiment. This intermittent rotation is performed, e.g., in a cycle in which rotation occurs for 30 seconds and is stopped for five minutes, and the cycle is repeated 10 times. In the final cycle, the five-minute stoppages are not performed. The rotation of the grinding blade **90** may be continuous, but intermittent rotation is preferred in order, e.g., to prevent the temperature of the ingredients in the bread container **80** from becoming excessively high, and for other purposes.

[0104] The possibility that rice grains will fly out of the bread container **80** in the grinding step is low because grinding is carried out inside the cover **100**. The rice grains that enter into the cover **100** from the aperture part **114** of the guard **110**, which is not rotating, are sheared between the rotating grinding blade **90** and the stationary spokes **113** and are therefore ground with good efficiency. Also, the rice grains are ground with good efficiency because the flow (flow in the same direction as the rotation of the grinding blade **90**) of the rice-grain and water mixture is minimized by the ribs **106** provided to the cover **100**.

[0105] The ground rice-grain and water mixture is guided by the ribs **106** in the direction of the windows **105** and discharged from the windows **105** to the exterior of the cover **100**. The mixture is unlikely to pool on the surface of the ribs **106** and the mixture smoothly flows toward the windows **105** because the ribs **106** are curved so that the side facing the mixture, which is pressing against the ribs, is convex. The mixture present in the space above the recess **81** furthermore enters into the recess **81**, passes from the recess **81** through the aperture part **114** of the guard **110**, and enters into the cover **100** to replace the mixture that has been discharged from the interior of the cover **100**. Grinding by the grinding blade **90** is carried out under the formation of such an environment so grinding can be achieved with good efficiency.

[0106] In the automatic bread maker **1**, the control apparatus **120** controls the driving of the fan **17** so that an effective cooling effect can be obtained in the case that the grinding step is executed. Accordingly, it is possible to inhibit an excessive increase in the temperature of the bread ingredients in the bread container **80**.

[0107] The grinding step is ended in a predetermined length of time in the automatic bread maker **1** (50 minutes in the present embodiment). However, the hardness of the rice grains may vary, and the granularity of the ground flour may vary depending on ambient conditions. Therefore, it is possible to configure the automatic bread maker **1** so that the magnitude of the load on the grinding motor **60** during grinding (which can be determined by, e.g., the control current or the like of the motor) is used as an indicator for determining the end of the grinding step.

[0108] Upon completion of the grinding step, a kneading step is subsequently performed. The kneading step must be performed at a temperature (e.g., about 30° C.) at which the yeast can actively work. It is therefore preferred that the kneading step be started when the temperature (measured directly or indirectly) of the ingredients inside the bread container **80** has reached a predetermined temperature range. As described above, the temperature of the bread ingredients does not increase excessively and the kneading step can be smoothly started because the fan **17** is driven during the grinding step in the automatic bread maker **1**.

[0109] At the start of the kneading step, gluten, as well as seasonings such as salt, sugar, and shortening are fed into the bread container **80** by the respective amounts. These bread ingredients may be fed, for example, manually by the user, or automatically by providing an automatic feeding apparatus that will free the user from this task.

[0110] Gluten is not an essential bread ingredient. Gluten can therefore be added to the bread ingredients as deemed necessary by the user. A wheat flour or a thickening stabilizer (e.g., guar gum) may be fed together with gluten or in place of gluten. The amount of seasonings such as salt, sugar, and shortening may be suitably modified in accordance with the preference of the user.

[0111] At the start of the kneading step, the control apparatus **120** drives the solenoid **73** so that the clutch **56** transmits power (the state shown in FIG. 3B). In the automatic bread maker **1**, the control apparatus **120** also drives the fan **17** (refer to FIG. **12**) in the kneading step subsequent to the grinding step. This is done to inhibit a situation in which the temperature inside the baking compartment **30** increases due, inter alia, to the rotation of the kneading motor **50** in the kneading step, and the temperature of the bread ingredients departs from a desired temperature (a desired temperature for allowing the yeast to actively work, e.g., about 30°).

[0112] When the control apparatus **120** controls the kneading blade **50** and causes the blade rotation shaft **82** to rotate in the forward direction, the grinding blade **90** also rotates in the forward direction and the bread ingredients around the grinding blade **90** flow in the forward direction. When the cover **100** moves in the forward direction (the counter-clockwise direction in FIG. **8**) in accompaniment therewith, the kneading blade **102** undergoes resistance from the bread ingredients that are not flowing and changes angle from an open orientation (refer to FIG. **8**) to a folded orientation (refer to FIG. **7**). When the second engaging body **104*b*** reaches an angle that interferes with the rotation trajectory of the first engaging body **104*a***, the cover clutch **104** engages and the cover **100** is set at an attitude at which it is fully driven by the rotation of the blade rotation shaft **82**. The cover **100** and the kneading blade **102** in the folded orientation both rotate in the forward direction together with the blade rotation shaft **82**.

[0113] As described above, when the kneading blade **102** is in the folded orientation, the complementary kneading blade **103** aligns along the extension of the kneading blade **102** as if to enlarge the kneading blade **102**, and the bread ingredients are forcibly pressed. The dough can therefore be thoroughly kneaded.

[0114] The rotation of the kneading blade **102** and the complementary kneading blade **103** in the kneading step may be continuous from beginning to end, but in the automatic bread maker **1**, the rotation is intermittent in the initial stage of the kneading step and is continuous in the latter half of the kneading step. In the present embodiment, yeast (e.g., dry yeast) is fed at the stage where the intermittent rotation carried out initially has ended. The yeast may be fed by the user, or may be automatically fed. The reason for not feeding the yeast with the gluten or the like is to prevent the yeast from coming into direct contact with water as much as possible. Depending on the situation, the yeast, gluten and the like may be fed simultaneously.

[0115] The bread ingredients are mixed and kneaded by the rotation of the kneading blade **102** and the complementary kneading blade **103** to become an integrated ball of dough having a prescribed elasticity. The kneading blade **102** and the complementary kneading blade **103** toss the dough about and beat it against the inner wall of the bread container **80**, adding the element of "kneading" to the mixing. The cover **100** also rotates together with the kneading blade **102** and the complementary kneading blade **103**. When the cover **100** rotates, the ribs **106** formed on the cover **100** also rotate, and the bread ingredients inside the cover **100** are rapidly discharged from the windows **105**. The discharged bread ingredients are assimilated into the mass (dough) of bread ingredients being kneaded by the kneading blade **102** and the complementary kneading blade **103**.

[0116] In the kneading step, the guard **110** also rotates in the forward direction together with the cover **100**. The spokes **113** of the guard **110** are shaped so that the center side of the guard **110** leads and the external peripheral side of the guard **110** trails during forward rotation. For this reason, the guard **110** rotates in the forward direction, whereby the bread ingredients inside and outside the cover **100** are pressed outward with the aid of the spokes **113**. The ratio of starting material discarded after the bread has been baked can thereby be reduced.

[0117] The bread ingredients at the periphery of the cover **100** are thrown upward at the front surface of the columns **115** during kneading because the columns **115** of the guard **110** are configured so that the side surfaces **115***b* (refer to FIG. **9**) are sloped upward, the side surfaces **115***b* being the front surface in the direction of rotation when the guard **110** rotates in the forward direction. The ratio of starting material that is discarded after the bread has been baked can therefore be reduced.

[0118] In the automatic bread maker **1**, the time for the kneading step may be a predetermined time (10 minutes in the present embodiment) obtained by experimentation as the time required to obtain a bread dough having desired elasticity. However, when the time for the kneading step is fixed, the quality of the bread dough may vary due to ambient temperature or another factor. Therefore, it is possible to use a configuration in which, e.g., the magnitude of the load on the kneading motor **50** (which can be determined by, e.g., the control current or the like of the motor) is used as an indicator for determining the end time of the kneading step.

[0119] When bread containing additional ingredients (e.g., raisins, nuts, and cheese) is baked, the additional ingredients can be fed during the kneading step.

[0120] When the kneading step is ended, a fermentation step is started according to an instruction from the control apparatus **120**. When the fermentation step is started, the control apparatus **120** stops the drive of the fan **17** and thereafter does not allow the fan **17** to be driven until the bread is baked. In the fermentation step, the control apparatus **120** controls the sheath heater **31** and keeps the temperature of the baking compartment **30** to a temperature (e.g., 38° C.) that facilitates fermentation. The bread dough is left standing for a predetermined time (60 minutes in the present embodiment) in an environment that facilitates fermentation.

[0121] Depending on the situation, a process such as causing the kneading blade **102** and the complementary kneading blade **103** to rotate, and causing the dough to deflate or become rounded may be performed during the fermentation step.

[0122] When the fermentation step is ended, a baking step is started by an instruction from the control apparatus **120**. The control apparatus **120** controls the sheath heater **31** and increases the temperature of the baking compartment **30** to a temperature (e.g., 125° C.) suitable for baking bread. The bread is baked for a predetermined time (**50** minutes in the present embodiment) in a baking environment. The user is notified of the end of the baking step by, e.g., a display on a liquid crystal display panel of the operation part **20**, an audio alert, or the like. When the bread-making is detected to be complete, the user opens the lid **40** and removes the bread container **80** to complete the bread making.

[0123] Bake marks of the kneading blade **102** and the complementary kneading blade **103** remain in the bottom of the bread, but since the cover **100** and the guard **110** are accommodated in the recess **81**, large bake marks are not left in the bottom of the bread. It is also possible to use a configuration in which the fan **17** is driven by the control apparatus **120** to cool the bread container **80** at a stage when the baking step has ended.

Other Embodiments

[0124] The embodiment indicated above is an example of the present invention, but the configuration of an automatic bread maker in which the present invention is applied is not limited by the embodiments indicated above.

[0125] For example, in the embodiment indicated above, a configuration is adopted wherein the control apparatus **120** causes the fan **17** to be driven during the grinding and kneading steps. However, the present invention shall not be construed to be limited to this configuration, and it is possible to use a configuration in which, e.g., the control apparatus **120** causes the fan **17** to be driven only during the grinding step, or another configuration may be used. During bread making, the temperature of the baking compartment **30** may be detected using a temperature sensor **15** (an embodiment of the temperature detector of the present invention; refer to FIG. **11**), and the drive of the fan **17** may be controlled on the basis of the temperature thus detected. Such control is effective because the manner in which the temperature of the ingredients inside the bread container **80** accommodated in the baking compartment **30** changes will vary depending on fluctuation in the ambient temperature of the automatic bread maker **1**.

[0126] In the embodiment described above, a configuration is adopted in which the fan **17** is automatically controlled by the control apparatus **120**. However, the present invention is not limited to this configuration; it is also possible to use a configuration in which, e.g., the fan **17** is driven with the preferred timing of the user using a switch provided to the body **10**, or another configuration may be used.

[0127] In the embodiment described above, the cooling mechanism was configured using a fan **17** of a type that draws out air from the baking compartment **30**, but the present invention shall not be construed to be limited thereby. In other words, it is also possible to use a configuration in which the cooling mechanism for cooling the baking compartment **30** is configured using a fan of a type that blows air from the exterior into the baking compartment **30**.

[0128] Described above is the case in which bread is made by the automatic bread maker using rice grains as a starting ingredient, but the automatic bread maker of the present embodiment can make bread using, e.g., wheat flour or rice flour as a starting ingredient. The grinding blade **90** is not required in the case that wheat flour or rice flour is used as the starting ingredient, and it is therefore possible to use a bread container (a conventional bread container in which only a kneading blade is mounted on the blade rotation shaft) that is different from the one indicated above.

[0129] In the case that a cereal flour (milled flour) such as wheat flour or rice flour is used as the starting ingredient, the control apparatus **120** executes bread-making steps that include a kneading step for causing the kneading blade to rotate and knead bread dough inside the bread container into which cereal flour and, e.g., yeast (dry yeast or the like), seasonings (salt, sugar, shortening or the like), gluten, guar gum or another thickener, and other bread ingredients have been put; a fermentation step for allowing the kneaded bread dough to ferment; and a baking step for baking the fermented bread dough. Gluten and thickener are not necessarily required and may be added as required. Gluten and thickener are often used in the case that rice flour is used as the cereal flour. In the fermentation step, a gas-purging step for purging gas from the bread dough, or a rounding step for rounding the bread dough may be suitably performed. In the case that such bread-making steps are to be executed, the control apparatus **120** may control the drive of the fan **17** on the basis of temperature information from the temperature sensor **15** for detecting the temperature of the baking compartment **30**. For example, the temperature of the baking compartment **30** may at times increase above a desired temperature in each step during the summer season and result in poor-quality bread. However, the fan **17** can be suitably driven on the basis of the temperature information (such control is effective in, e.g., the kneading step), whereby the effect of the ambient temperature can be inhibited and good quality bread can be made.

[0130] In the embodiments described above, the configuration and operation of the automatic bread maker were described using an example in which rice grains are used as the starting ingredient. However, the automatic bread maker of the present invention may also be applied to the case in which, e.g., wheat, barley, millet, Japanese millet, buckwheat, corn, soy beans, or other cereal grains other than rice grains are used as the starting ingredient.

[0131] The bread-making steps carried out in the above-described rice-grain bread-making procedure are merely examples, and other steps may be employed. Another example is to carry out the immersion step again and thereafter carry out the kneading step in order to cause the ground flour to absorb the water after the grinding step.

Industrial Applicability

[0132] The present invention is suitably used in an automatic bread maker for household use.

List of Reference Signs

[0133] **1** automatic bread maker
[0134] **10** body
[0135] **15** temperature sensor (temperature detector)
[0136] **16** duct
[0137] **17** fan
[0138] **30** baking compartment (accommodation part)
[0139] **30***b* sidewall of the baking compartment (sidewall of the accommodation part)
[0140] **30***bf* front sidewall of the baking compartment (first sidewall)
[0141] **30***bb* rear sidewall of the baking compartment (second sidewall)
[0142] **31** sheath heater (heating part)
[0143] **32** first ventilation holes
[0144] **33** second ventilation holes
[0145] **50** kneading motor (second motor)
[0146] **60** grinding motor (first motor)
[0147] **80** bread container
[0148] **90** grinding blade
[0149] **102** kneading blade
[0150] **103** complementary kneading blade
[0151] **120** control apparatus (control unit)

1. An automatic bread maker comprising:
a bread container into which bread ingredients are put;
a body having an accommodation part for accommodating the bread container;
a grinding blade for grinding cereal grains inside the bread container accommodated in the accommodation part; and
a duct and fan for creating an airflow cooling the accommodation part using ventilation holes provided in the accommodation part.

2. The automatic bread maker of claim **1**, further comprising a first motor provided inside the body in order to cause the grinding blade to rotate.

3. The automatic bread maker of claim **2**, wherein
further comprising a control unit for executing bread-making steps, the bread-making steps including a grinding step for causing the grinding blade to rotate and grind cereal grains inside the bread container into which cereal grains and a liquid have been put, wherein
the control unit drives the fan in the case that the grinding step is executed.

4. The automatic bread maker of claim **2**, further comprising:
a kneading blade for kneading bread ingredients into bread dough inside the bread container accommodated in the accommodation part;
a second motor provided inside the body in order to cause the kneading blade to rotate;
a heating part provided to the accommodation part; and
a control unit for causing bread-making steps to be executed, the bread-making steps including a grinding step for causing the grinding blade to rotate and grind cereal grains inside the bread container into which cereal grains and a liquid have been put, a kneading step for causing the kneading blade to rotate and knead bread dough inside the bread container into which bread ingredients including ground flour obtained by grinding cereal grains have been put, a fermentation step for causing kneaded bread dough to ferment, and a baking step for baking fermented bread dough, wherein
the control unit drives the fan in the case that at least the grinding step of the bread-making steps is executed.

5. The automatic bread maker of claim **1**, further comprising
a temperature detector for detecting the temperature of the accommodation part; and
a control unit for controlling drive of the fan on the basis of temperature information obtained from the temperature detector.

6. The automatic bread maker of claim **1**, wherein the ventilation holes are formed so that a part of a sidewall of the accommodation part is made to protrude in a direction facing the exterior of the accommodation part.

7. The automatic bread maker of claim **1**, wherein
first ventilation holes and second ventilation holes are included in the ventilation holes provided to the accommodation part;
the accommodation part and the exterior of the body are in communication via the duct and the second ventilation holes; and
the fan takes air from the exterior of the accommodation part into the accommodation part via the first ventilation holes, and exhausts air inside the accommodation part to the exterior of the body via the second ventilation holes and the duct.

8. The automatic bread maker of claim **7**, wherein the first ventilation holes are formed in a first sidewall of the accommodation part, the second ventilation holes are formed in a second sidewall of the accommodation part, and the first sidewall and the second sidewall face each other.

9. The automatic bread maker of claim **1**, wherein the fan is provided inside the duct.

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